Final

Lower Duwamish Waterway Slip 4 Early Action Area

Revised Work Plan for Investigation Tasks

integral consulting inc

Submitted to:
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, WA 98101

Submitted by:
City of Seattle
King County

Prepared by
integral consulting inc.

June 3, 2004

KCSlip4 56176

SEA422500

LOWER DUWAMISH WATERWAY
SLIP 4 EARLY ACTION AREA

REVISED WORK PLAN FOR INVESTIGATION TASKS

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ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLP	Contract Laboratory Program
DQO	data quality objective
Ecology	Washington Department of Ecology
EE/CA	Engineering evaluation and cost analysis
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RI	remedial investigation
SAP	sampling and analysis plan

INTRODUCTION

This work plan describes activities related to the initiation of early actions for the cleanup of Slip 4 at the Lower Duwamish Waterway (LDW) Superfund Site in Seattle Washington. The LDW was placed on the National Priorities List on September 13, 2001 in response to elevated concentrations of chemicals in sediments and some fish tissues. Slip 4 was identified as a candidate early action site (Windward 2003) during the first phase of the LDW remedial investigation.

The work plan was prepared based on the requirements in the May 2, 2003 letter from the U.S. Environmental Protection Agency (EPA) to the Lower Duwamish Work Group (LDWG). The LDWG is comprised of the City of Seattle, Port of Seattle, King County and The Boeing Company. Slip 4 early actions described in this work plan will be performed by the City of Seattle and King County pursuant to Tasks 9 and 10 of the Statement of Work for the LDW Administrative Order on Consent.

The purposes of the activities described in this work plan are to implement tasks to characterize sediment quality in the Slip 4 Early Action Area (Figure 1), evaluate potential sources to the slip, prepare an Engineering Evaluation and Cost Analysis (EE/CA), prepare a Clean Water Act (CWA) 404(b)(1) memorandum as needed, and support EPA's associated public involvement activities.

The following tasks associated with the Slip 4 Early Action Area are described in this work plan:

1. Preparation of a report summarizing existing information and a sampling and analysis plan (SAP), including a field sampling plan (FSP), quality assurance project plan (QAPP), and health and safety plan (HSP).
2. Preparation of a cruise and data report (including data validation report).
3. Preparation of a technical memorandum that identifies the proposed boundary of the removal action in the Slip 4 Early Action Area.
4. Preparation of an Engineering Evaluation/Cost Analysis (EE/CA) that develops and recommends a removal action alternative.
5. If dredging, capping or filling is proposed by Respondents in the EE/CA, then Respondents will prepare a memorandum that addresses the substantive requirements of Section 404(b)(1) of the Clean Water Act.

The original Slip 4 Work Plan, dated October 16, 2003, addressed Tasks 1, 2 and 3 above. The remainder of this revised work plan contains a description of the tasks to be undertaken, the contents of the required documents, and the project schedule. Qualifications of the contractors performing the work and resumes of key personnel are contained in Appendices A and B, respectively.

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integral consulting inc.

Slip 4 Early Action Area
Lower - Duwamish Waterway
Superfund Site

Figure 1

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II. WORK TO BE PERFORMED

TASK 1 - SUMMARY OF EXISTING INFORMATION AND IDENTIFICATION OF DATA GAPS REPORT AND SAMPLING AND ANALYSIS PLANS

Summary of Existing Information and Identification of Data Gaps Report

A Summary of Existing Information and Identification of Data Gaps Report will be prepared, which will include, at a minimum, the following information:

- Introduction/Purpose
- Brief description of Slip 4 Early Action Area characteristics, including ecological and physical characteristics
- Identification of property owners and other operators in the Slip 4 Early Action Area, and owners and operators of all immediately adjacent upland property
- Description of the nature and extent of contamination, to the extent it can be determined, within the vicinity of the Slip 4 Early Action Area, including a summary of existing sediment data with a comparison to Washington State Sediment Management Standards (Sediment Quality Standards and Cleanup Screening Levels)
- Discussion of known and potential contaminants of concern
- Summary of available existing information on all environmental investigations and cleanups on adjoining properties
- Summary of potential ongoing and historical sources of contamination to the Slip 4 Early Action Area to the extent they can be determined, and, for each source, a description of the types of information that would support the EPA/Washington State Department of Ecology (Ecology) Baseline Source Control Matrix for the Lower Duwamish Waterway Superfund Site
- Other information (including maps and figures), as necessary, to gain a general understanding of the Slip 4 Early Action Area.

Data gaps will be identified through use of EPA's (2000) data quality objectives (DQO) process. DQOs that address site characterization and the potential for recontamination will be developed and data gaps identified. The data gaps will be filled by the collection and analysis of field data. Investigation activities will focus on defining the site boundary,

resulting in data of adequate technical content to evaluate potential ecological and human health risks and support development of an analysis of alternatives in a possible future EE/CA.

The City and County will submit to EPA a complete list of previous studies or sampling efforts conducted independently, or under state, local, or other federal authorities or agreements, that may assist in describing site history and land use, in defining the nature and extent of sediment contamination, and in identifying possible sources of recontamination in the Slip 4 Early Action Area. Upon request by EPA, copies of documents will be submitted to EPA.

Additionally, the City and County will continue to work with Ecology and EPA on source control efforts related to the Slip 4 Early Action Area, which may include identifying sources; prioritizing, documenting, and tracking of source control plans and completed source control actions; evaluating and documenting effectiveness of source control measures; and providing input to EPA and Ecology's decision regarding whether source control is adequate to move forward with the early action. Generally, significant continuing sources should be controlled to the greatest extent possible before or concurrent with cleanup of sediment.

Sampling and Analysis Plans

The procedures for conducting all field activities will be detailed in a SAP to ensure that sample collection and analytical activities are conducted in accordance with technically acceptable protocols and that data meet data quality objectives. The SAP will provide a mechanism for planning field activities and consists of a FSP and a QAPP (additional details are provided in Section III of this SOW). The contents of the SAP will incorporate the type of information described in EPA's (1988) Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA (e.g., see Appendix B of the Guidance). A health and safety plan that is designed to protect onsite personnel and area residents from physical, chemical, and other hazards posed by field sampling efforts will be submitted with the SAP.

TASK 2 - CRUISE AND DATA REPORT

A cruise and data report that includes all information regarding the field sampling event, including validated analytical results, will be submitted following receipt of validated data. The cruise and data report will include, at a minimum, the following sections:

- Introduction/Purpose.

- Summary of field sampling effort, including information on sampling vessel, dates of field effort, summary of sample collection effort (e.g., surface sediment, subsurface sediment), field sample observations (e.g., sediment descriptions), summary of sample and station locations including station depths (corrected to mean lower low water), station locations (latitudes/longitudes and state plane coordinates), maps, and figures. Station locations will be provided electronically with the data.
- Deviations from the FSP.
- Summary of sample handling and shipment.
- Summary of all data.

A separate data validation report will be prepared for each field effort. It will be transmitted to EPA within 5 working days of receipt from the independent data validator. Respondents will provide EPA with information necessary (i.e., raw data) for EPA to perform an independent review of the validated data upon request. All sediment data will also be submitted electronically to EPA in SEDQUAL format.

TASK 3 - TECHNICAL MEMORANDUM ON PROPOSED BOUNDARIES OF THE REMOVAL ACTION

A draft technical memorandum on proposed boundaries of the removal action will be submitted to EPA following preparation of the data report. All available data will be considered for the development of an appropriate boundary for the removal action, and the technical memorandum will provide a rationale for the proposed boundary. Data interpretation will be consistent with the spatial analysis approaches agreed upon by EPA for the overall LDW site.

TASK 4 – ENGINEERING EVALUATION/COST ANALYSIS

Based on data obtained in previous sampling efforts, and in consideration of EPA's guidance for removal actions, Respondents will prepare a technical briefing for EPA on proposed removal alternatives that will be presented by Respondents in the EE/CA.

After the technical briefing, Respondents, in consideration of comments received from EPA at the technical briefing, will submit a first draft EE/CA. The first draft EE/CA will be revised in response to EPA comments, and a second draft EE/CA shall be submitted to EPA for release to a formal public comment period, following EPA approval and modification if

necessary if EPA comments are not adequately addressed. As requested by EPA, a final version of the EE/CA shall be submitted to EPA for review and approval in accordance with the schedule set forth in Table 1 of this SOW.

The EE/CA will contain the following sections:

- Executive Summary
- Introduction
- Site Characterization, including the identification of continuing sources and an evaluation of currently available information on their potential to recontaminate sediments
- Identification of Removal Action Objectives
- Identification and Analysis of Removal Action Technologies
- Identification and Analysis of Removal Action Alternatives
- Comparative Analysis of Removal Action Alternatives
- Recommended Removal Action Alternative
- Schedule.

For non-time-critical removal actions, the National Contingency Plan (NCP) requires a 30-day public comment period on the EE/CA and any supporting documentation at the time the EE/CA is made available for public comment. Respondents shall assist EPA as requested prior to and during the comment period with its community relations activities concerning the EE/CA.

TASK 5 - CLEAN WATER ACT 404 MEMORANDUM

If dredging, capping, or other filling is proposed by Respondents (or selected by EPA), Respondents shall submit a draft "404 memorandum" that provides sufficient information to support compliance with the substantive requirements of Section 404(b)(1) of the Clean Water Act. The memorandum shall document the information gathered regarding practicability and cost, long- and short-term impacts from all such proposed alternatives, minimization of adverse effects, and an analysis of the need for mitigation, if any.

COMMUNITY INVOLVEMENT

The City and County will follow the EPA's communication and coordination strategy (Keeley 2003) and send electronic and hard copies of all draft and final deliverables to

Karen Keeley (EPA) and Kymberly Takasaki (U.S. Army Corps of Engineers). At the same time, the City and County will also send electronic draft and final deliverables of Tasks 1 and 3, and final deliverables for Task 2, to the following EPA staff and external stakeholders: Lon Kissinger, EPA; Erika Hoffman, EPA; Bruce Duncan, EPA; Allison Hiltner, EPA; Cindy Schuster, EPA; Rick Huey, Ecology; B.J. Cummings, Duwamish River Cleanup Coalition; Glen St. Amant, Muckleshoot Tribe; Alison O'Sullivan, Suquamish Tribe; Craig Thompson, Ecology, State Trustee; Randy Carman, Washington Department of Fish and Wildlife; Marla Steinhoff, NOAA; Jeff Krausmann, U.S. Fish and Wildlife Service; and Greg Wingard, Waste Action Project. Hard copies of draft and final deliverables, or figures and photos from these documents, will be mailed to stakeholders upon request by EPA.

III. CONTENT OF SUPPORTING PLANS

SAMPLING AND ANALYSIS PLAN

The SAP will be project-specific and will be comprised of a project-specific FSP and project-specific QAPP for sample analysis and data handling for any samples collected from the Slip 4 Early Action Area. The SAP will be based upon EPA guidance. As appropriate, the SAP will ensure that sample collection and analytical activities are conducted in accordance with the Puget Sound Estuary Program protocols. Sediment sampling will also be conducted in a manner that is consistent with sampling being performed by the RI team for the LDW Superfund Site so that the resulting data can also be used by the LDW RI team during the Phase 2 RI and risk assessment for the LDW.

The FSP will detail the sampling and data-gathering methods that will be used during the project. It will include sampling objectives, a detailed description of sampling activities, sample locations, sample analyses, sampling equipment and procedures, sampling schedule, station positioning, and sample handling procedures (e.g., sample containers and labels, sample preservation). It may include surface and subsurface sediment chemical and biological sampling, source sampling, a geophysical survey (including consideration of precision bathymetric survey, subbottom profiling, and/or side scan sonar), example field forms, and standard operating procedures.

The QAPP will describe the quality assurance and quality control protocols necessary to achieve required DQOs. The QAPP will be prepared in accordance with EPA Requirements for Quality Assurance Project Plans (QA/R-5) (EPA 2001c) and EPA Guidance on Quality Assurance Project Plans (QA/G-5) (EPA 2001a). The QAPP will address sampling procedures; sample custody; analytical procedures; and data reduction, validation, reporting; and personnel qualifications.

The laboratory performing the work must follow an approved quality assurance (QA) program that complies with EPA Requirements for Quality Management Plans (QA/R-2) (EPA 2001b), or equivalent documentation as determined by EPA. If a laboratory not in the EPA Contract Laboratory Program (CLP) is selected, the QAPP will be consistent with the requirements of the CLP for laboratories proposed outside the CLP. Upon request, EPA may have access to laboratory personnel, equipment, and records for sample collection, transportation, and analysis, and may conduct a performance audit.

All sampling and analyses will conform to EPA direction, approval, and guidance regarding sampling, quality assurance/quality control (QA/QC), data validation, and chain-of-custody procedures.

Upon request by EPA, City of Seattle/King County will analyze samples submitted by EPA for QA monitoring and will allow EPA or its authorized representatives to take split and/or duplicate samples. City of Seattle/King County will notify EPA not less than 14 days in

advance of any sample collection activity, unless shorter notice is agreed to by EPA. EPA will have the right to take any additional samples that EPA deems necessary. Upon request, EPA will allow City of Seattle/King County to take split or duplicate samples of any samples it takes as part of its oversight of City of Seattle/King County's implementation of the work.

HEALTH AND SAFETY PLAN

The HSP ensures protection of the public health and safety during performance of onsite Work. This plan will be prepared in accordance with EPA's (1992) Standard Operating Safety Guide. In addition, the plan will comply with all currently applicable Occupational Safety and Health Administration regulations found at 29 CFR 1910. Respondents will implement the plan during the duration of the work described in the work plan.

IV. SUMMARY OF MAJOR DELIVERABLES/SCHEDULE

The schedule for submission of deliverables described herein is presented in Table 1.

TABLE 1. Project Schedule [1,2,3]

Task 1	A.1 Draft Summary of Existing Information Report and Identification of Data Gaps A.2 Final Summary of Existing Information Report and Identification of Data Gaps	A.1 Within 49 days of EPA approval of the work plan. A.2 Within 21 days after receipt of written EPA comments on the draft report.
	A.1 Draft Sampling and Analysis Plan A.2 Final Sampling and Analysis Plan	A.1 Within 35 days of receipt of EPA comments on the draft Summary of Existing Information and Identification of Data Gaps report A.2 Within 21 days of receipt of written EPA comments on the draft SAP
Task 2	Field Sampling	Within 14 days of EPA approval of the SAP. NOTE: Intertidal sampling will occur during daylight low tides, which are available March – October. Consequently, intertidal sampling may be decoupled from subtidal sampling.
	Chemical Data Validation Report: Subtidal Data Chemical Data Validation report: Intertidal Data	Within 7 days after receipt of the validation report from the independent validator Within 7 days after receipt of the validation report from the independent validator
	A.1 Draft Cruise and Data Report A.2 Final Cruise and Data Report	A.1 Within 35 days after receipt of final validated chemistry package A.2 Within 28 days after receipt of EPA comments on draft report.

Task 3	A.1 Draft Technical Memorandum on Proposed Boundaries of the Removal Action A.2 Revised Draft Technical Memorandum on Proposed Boundaries of the Removal Action	A.1 Within 14 days after EPA approval of final Cruise and Data Report to EPA. A.2 Within 56 days after receipt of EPA comments on draft memorandum.
Task 4	A.1 Technical Briefing on Proposed Removal Alternatives A.2 First Draft EE/CA A.3 Second Draft (Public Review) EE/CA A.4 Final EE/CA	A.1 Within 100 days after receipt of EPA comments on the Draft Memorandum on Proposed Boundaries of the Removal Action A.2 Within 40 days of the Technical Briefing on Proposed Removal Alternatives. A.3 Within 30 days after receipt of EPA comments on first draft EE/CA. A.4 Within 30 days after receipt of EPA comments on second draft EE/CA.
Task 5	A.1 Draft Clean Water Act 404 Memorandum (as requested by EPA) A.2 Revised Draft Clean Water Act 404 Memorandum	A.1 Within 40 days of the Technical Briefing on Proposed Removal Alternatives A.2 Within 30 days after receipt of EPA comments on the draft.

[1] EPA will endeavor to provide comments on draft reports no more than 21 days after receipt and provide approvals of final documents no more than 14 days after receipt.
[2] All days are calendar days.
[3] The schedule dates in the approved October 16, 2003 Work Plan were in working days. They have been converted to calendar days in this revised work plan.

V. PROJECT TEAM AND RESPONSIBILITIES

The Slip 4 Early Action Area Investigation will be performed by a different consulting team than is conducting the LDW RI. The team, including their designated lead personnel and general areas of responsibility for the Slip 4 Early Action Area project, includes:

Integral Consulting: Site investigation, source evaluation, EE/CA, 404 memorandum

- Betsy Striplin – Project Manager
- Vicki Fagerness – Deputy Project Manager
- Reid Carscadden, P.E. – Senior Engineer
- Gary Pascoe – Risk Assessor

Parsons Brinckerhoff (PB): Integration of data needs for an analysis of alternatives, EE/CA support

- Jerry Ramsden, P.E. – Engineer

VI. REFERENCES

EPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. Interim Final, (OWSER Directive 9355.3-01). EPA 540 G-89 004. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

EPA. 1992. Standard Operating Safety Guide. PB92-963414. U.S. Environmental Protection Agency, Washington, DC.

EPA. 2000. Guidance for the Data Quality Objectives Process (QA/G-4). EPA/600/R-96/055. U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC.

EPA. 2001a. EPA Guidance for Quality Assurance Project Plans (QA/G-5). EPA/240/R-02/009. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 2001b. EPA Requirements for Quality Management Plans (QA/R-2). EPA/240/B-01-002. U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC.

EPA. 2001c. EPA Requirements for Quality Assurance Project Plans (QA/R-5). EPA/240/B-01/003. U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Keeley, K. 2003. Personal communication (email of January 30, 2003 to B. Striplin regarding EPA's communication and coordination strategy). U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Windward. 2003. Lower Duwamish Waterway Remedial Investigation, Task 5: Identification of Candidate Sites for Early Action, Technical Memorandum: Data Analysis and Candidate Site Identification. Prepared for the Lower Duwamish Waterway Group. Windward Environmental, 200 West Mercer Street, Seattle, WA.

APPENDIX A

STATEMENT OF QUALIFICATIONS

INTEGRAL CONSULTING, INC.
CORPORATE OVERVIEW

Integral Consulting Inc. (Integral) provides science and engineering consulting for environmental, health, and natural resources projects. We focus on developing cost-effective solutions to the complex technical challenges faced by our clients in the industrial, legal, and institutional sectors. We also provide client support in the areas of project planning and management, regulatory strategy development, technical peer review, and expert services for litigation.

TECHNICAL CAPABILITIES

Risk Assessment and Toxicology
- Human health risk assessment
- Ecological risk assessment
- Risk-based remediation and restoration plans
- Environmental/occupational regulatory compliance
- Regulatory toxicology
- Product safety and stewardship
- Exposure, toxicology, and bioavailability studies

Environmental Investigation
- Site characterization under CERCLA, RCRA, and state programs
- Hydrologic, geologic, and geochemical investigations
- Environmental modeling
- Chemical fate and transport analysis
- Mine pit-lake, waste rock, and tailings studies
- Environmental chemistry and QA/QC management

Engineering and Remediation
- Soil, groundwater, and sediment remediation evaluations
- Feasibility studies and corrective action plans
- Bench- and pilot-scale treatability testing
- Remediation system audits and optimization
- Remedial design oversight
- Cost estimation

Sediment Science and Management
- Site characterization
- Source identification and loading allocation
- Sediment remediation evaluation
- Design oversight/feasibility studies
- Construction oversight and long-term monitoring
- Dredged material evaluation

Environmental Assessment and Planning
- Mine permitting and closure studies
- NEPA/SEPA evaluations
- Ecological surveys and biomonitoring
- Habitat identification, assessment, and mapping
- Regulatory analysis and permitting support

Natural Resource Damage Assessment
- Strategic guidance
- Injury assessments
- Source apportionment and allocation

Environmental Forensics
- Chemical fingerprinting
- Timing of release analyses
- Source identification and allocation
- Chemometrics

Mercer Island, Washington (206) 230-9600 | *Olympia, Washington (360) 705-3534* | *Boulder, Colorado (303) 444-5677* | *Portland, Oregon (503) 284-5545* | *Annapolis, Maryland (410) 798-1330*

Sediment Management

Integral Consulting provides comprehensive sediment management services to meet our clients' technical needs for development of ports, harbors, and waterfronts; navigational dredging in rivers and estuaries; hazardous waste site evaluation and remediation; management of sediments in lakes, rivers, and impoundments; and restoration/recovery of wetland and aquatic habitat for sensitive species. Depending on the environmental and regulatory setting, chemically contaminated sediments often represent a concern to human or ecological health. To address these issues, Integral Consulting has fully integrated its risk sciences expertise with its sediment management and natural resources capabilities.

Services

- ***Site Characterization***—Integral scientists and engineers have expertise in the selection, application, and interpretation of the full array of sediment assessment tools, including specialized chemical analyses, toxicity testing, bioaccumulation measurements, bathymetric surveying, geophysical testing, leachate and extraction analysis, dating methods, and GIS analysis.
- ***Source Identification and Loading Allocation***—Sediment contamination often results from historical releases from a number of sources, particularly in urban environments. Integral scientists apply a variety of techniques to characterize historical and ongoing source loading, distinguish the relative contributions of different sources, and allocate responsibility and response costs. Methods include spatial analysis; chemical "fingerprinting"; statistical methods; dating with radioisotopes or pollen; and toxicity, exposure, and causation evaluation.
- ***Remedial Evaluations and Feasibility Studies***—Timely, cost-effective, and environmentally sound solutions are the central goal of Integral's contaminated sediment remediation projects. Integral's scientists and engineers assess sediment quality and integrate risk-based chemical and biological criteria to distinguish areas requiring cleanup from those suited for monitored natural recovery. We apply these findings to develop focused, cost-effective preliminary remedial designs.
- ***Sediment Profile Imaging***—Sediment profile imaging (SPI) involves obtaining pictures of the top 20 centimeters of the seafloor. SPI data analysis determines *in-situ* seafloor properties including sediment type, biological features, seafloor disturbances, stratigraphy, and human impacts. Integral offers this service with in-house SPI equipment and scientists with more than 18 years of combined SPI experience.
- ***Construction Oversight and Long-term Monitoring***—Integral's scientists and engineers oversee construction activities to provide project continuity, represent client interests, and ensure that field changes are managed effectively. Additionally, we develop scientifically sound confirmation and long-term monitoring strategies to support final regulatory closure, while incorporating the flexibility needed to address the inherent uncertainties in sediment remediation.
- ***Dredged Material Evaluation***—Integral has helped federal, port, and private clients evaluate the potential physical, chemical, and biological impacts resulting from

dredged material disposal. Projects have included new construction, ongoing operation and maintenance programs, and projects regulated by the U.S. Army Corps of Engineers. Our experience encompasses a broad array of dredged material alternatives, including disposal in nearshore or upland confined facilities, open-water disposal, and beneficial reuse.

SELECT EXPERIENCE

- ***Pulp Mill Closure and Cleanup***—Integral is currently providing program management for strategic planning, site assessment, environmental management, and regulatory and public relations support for dismantling and remediation of a major pulp mill in Port Angeles, Washington. The mill underwent EPA's hazard ranking assessment for possible NPL listing, and Integral's scientists were instrumental in gaining approval of deferral to a state regulatory lead for the site cleanup. The project is occurring under the close scrutiny of state and federal agencies and environmental groups, and Integral's scientists have played a critical role in gaining consensus among the various stakeholders and keeping the cleanup on track. Interim remedial measures are currently being conducted to further streamline the cleanup. Integral is also conducting a remedial investigation on the upland and marine portions of the site to address residual contamination.

- ***Impacts from a Remediated Wood Treatment Facility***—Integral scientists and engineers are providing expert analysis and strategic support at a site that has resurfaced as part of a CERCLA five-year review. Issues addressed include the scope and technical basis for supplemental investigations, the exposure and risks from PAHs, dioxin, and metals, the development of focused sampling and analysis plans, the allocation of sources at a municipal dump that has caused impacts on sediments in a nearby creek, the evaluation of regional background exposure to mercury and PCBs in fish tissue, and the relationship between site-specific ecological and human health risks.

- ***Ward Cove Sediment Remediation Project***—Integral scientists directed technical activities related to sediment assessment and remedial design at a former pulp mill in Ketchikan, Alaska, including facilitating communication with regulators. Historical pulp mill releases consisted largely of partially degraded wood debris, organic matter, and organic matter degradation products, with low levels of dioxin. Realistic risk assessments demonstrated the absence of unacceptable risk to humans and wildlife. The presence of limited risks to the benthic community, the nature of chemicals of concern, and the type of sediment toxicity were the basis for developing an innovative remedy consisting of thin capping/sediment amendment (27 acres) and natural recovery (53 acres).

- ***Remedial Investigation and Feasibility Study of a Pulp Mill***—Integral scientists played key roles in the closure of Alaska Pulp Corporation's Sitka Mill Site. Problem chemicals included dioxins, resin acids, and trace metals. Integral scientists served as technical facilitators and risk communicators for a diverse group of stakeholders; designed and directed the sample collection; and performed human health and ecological risk assessments. Sediment toxicity and benthic community disturbance were primarily attributed to the effects of chemicals (*e.g.*, ammonia) generated by the decay of partially degraded wood waste, a byproduct from the pulping process. A state-of-the-science physiological-based biokinetic food chain model was used to evaluate exposure and risk to shorebirds, seabirds, sea otters, and harbor seals. This effort demonstrated that risks to marine birds and mammals in the vicinity of the site were negligible. Additionally, probabilistic

analyses were used to evaluate both human health and ecological risks assessments for the first time in Alaska and USEPA Region 10. The selection of the natural recovery alternative for a submerged wood deposition field was a landmark decision.

- ***Ecological Risk Approaches for Managing Petroleum Hydrocarbons in Terrestrial and Aquatic Habitats***—Integral scientists developed methods for predicting fate and transport, bioaccumulation, and toxicity of petroleum hydrocarbons to soil invertebrates, small mammals, and aquatic organisms for the Port of Seattle. The purpose of this project was to develop a new approach to evaluating risks and selecting cleanup action levels and remedies on properties affected by complex mixtures of petroleum contamination. These methods were then presented to the State Science Advisory board in a series of technical memoranda. Information from the various technical memoranda was then used to estimate and recommend risk-based screening levels for total petroleum hydrocarbons (TPH) in soils and groundwater. The evaluation of terrestrial receptors involved the estimation of bioaccumulation of hydrocarbon fractions in earthworms, and subsequent exposure to small mammals via predation. The BAF model incorporated estimates of the freely dissolved fraction of petroleum hydrocarbons in soil water, and therefore avoided unrealistic estimates of bioaccumulation of high end carbon fractions. The approach to aquatic receptors involved innovative use of the general model for chemically-induced narcosis in aquatic systems.
- ***Risk-based Monitoring of Chemical Contaminants in an Intertidal Seep Zone***—As part of a five-year monitoring program at a military installation along the shore of a Puget Sound bay, metals and semi-volatile organic chemicals were measured in groundwater, seeps, sediments and shellfish. Chemicals in subsurface soils and brackish groundwater are biologically inaccessible, and pose negligible risk to terrestrial organisms. However, groundwater transport and discharge can result in exposures of marine organisms, particularly in the intertidal zone where groundwater directly contacts marine sediments and shellfish. Integral scientists developed a monitoring program to 1) document the effectiveness of natural processes on attenuation of chemical concentrations in groundwater, and 2) develop site-specific measures of chemical exposure that could not be accurately predicted in a risk assessment. Results indicate that sediment and tissue sampling are effective monitoring endpoints of ecological risk, natural attenuation, and recovery of contaminated groundwater discharge into the marine environment.
- ***Restoration Alternatives Development and Evaluation***—On behalf of the Grand Calumet River Restoration Fund, the U.S. Fish and Wildlife Service is evaluating the effects of sediment contamination in the Grand Calumet River and the potential remediation and restoration of natural resource damages within selected portions of the river. Integral scientists provided technical management and coordination for the implementation of the chemical, physical and toxicological characterization of the West Branch of the river. The objective of this study was to conduct a bathymetry survey of the river and a topographic survey of the riverbanks and adjacent uplands, and to further characterize surficial and deeper historical sediments within portions of the river.
- ***Ecological Risk Assessment at a Wood Treatment Facility***—Integral scientists conducted an ecological risk assessment of the American Crossarm and Conduit facility as part of a CERCLA remedial investigation and feasibility study. The facility

manufactured wooden crossarms and conduits for telephone poles and pressure-treated the wood with chemical preservatives. Periodic flooding of the facility enhanced the migration of process chemicals into surrounding residential areas and wetlands. Contaminants of concern included pentachlorophenol, polycyclic aromatic hydrocarbons (PAHs), metals, and dioxins/furans. A modeling approach was used to assess potential risks to aquatic and terrestrial ecosystems. The structure and function of a large wetland on the site was assessed to evaluate potential risks from chemical releases and potential effects of remedial actions. Results of the risk assessment showed concerns to be low over most of the wetland and aquatic areas and helped focus remedial efforts on a small area affected by discharges from the facility outfall.

- ***Ecological Risk Assessment of Widespread Mining Impacts***—Integral scientists conducted the portions of the ecological risk assessment for the Coeur d'Alene Basin dealing with indirect ecological effects of releases of mining-related hazardous substances. Physical stressors associated with hazardous substances were identified (*e.g.*, riparian habitat degradation, increased bank erosion, increased stream water temperature). Risks to ecological endpoints of concern were qualitatively evaluated for each physical stressor. Results of the risk assessment were used to identify appropriate remedial measures that would enhance the ability to return the affected ecosystems to established ecological goals.
- ***Sediment and Source Loading Assessment***—For more than 100 years, the Grand Calumet River served as a settling pond for industrial releases from the industries that lined its banks. Integral scientists managed the preparation of a fast-track work plan, field sampling plan, and interpretative report to meet the requirements of a RCRA corrective action order. Chemicals of concern in sediment included metals, PCBs, dioxins, PAHs, metals, and oil constituents. Indicator chemicals were identified to delineate areas affected by site chemicals and distinguish historical site releases from historical and ongoing upstream loading. Sediment profiles were used to demonstrate the release chronology and the isolation of historical deposits from the environmentally relevant sediment interface (*i.e.*, upper 10 cm of sediment). Ongoing loading from steel manufacturers and very low natural sedimentation rates were demonstrated to be serious impediments to downstream sediment recovery. An innovative chemical-specific and effects-based approach was developed that related study objectives to the restoration of the impaired uses in a manner consistent with the requirements of the Great Lakes Initiative.
- ***Remedial Design of Sediment Cap***—The Thea Foss Waterway in Tacoma, Washington, has been used for industrial and commercial purposes since the late 1800s. Several industries have contributed to contamination of the waterway, including non-aqueous phase liquid (NAPL) in sediments. Integral scientists assisted in the design evaluation for placement of a 3-foot-thick isolation cap at the head of the waterway and prepared the contaminant mobility and geotechnical studies to evaluate a sand cap to protect the aquatic environment. Integral scientists also prepared a conceptual model of the driving mechanisms of the NAPL seep and assisted in the design evaluation of an isolation cap over this localized area. The design and construction of the impermeable cap is the first of its kind in the United States.
- ***Columbia Slough Remedial Investigation and Cleanup***—At a former mining equipment manufacturing site adjacent to the Columbia Slough, a remedial investigation was initiated to address metals,

PAHs, and PCBs in sediments and chlorinated solvents in upland groundwater. Integral scientists managed the human health and ecological risk assessments for the project; negotiated with regulators, assisted the local authority in revising existing permits, identified disposal options for dredged sediment and, worked with the local administrative authority for the slough to combine sediment removal activities at the site with an ongoing drainage control dredging project in the downstream areas. Having the local authority conduct the work resulted in a savings of 70 to 80 percent compared to a separate permitting and excavation project. Integral staff are currently finalizing the risk assessments to determine the residual risk posed by sediments remaining in the slough after the dredging.

- ***Channel Deepening in the Lower Columbia River***—Integral scientists managed technical support to the Port of Portland concerning possible impacts to salmonids of the Columbia River Deepening Project. The project team critically reviewed the scientific literature concerning key technical issues at the center of controversy among the various stakeholders and interveners for the deepening project. Issues included hydrodynamics (flow and salinity) associated with channel deepening, estuarine turbidity maximum, effects of turbidity on salmon, toxic contaminants in sediments, and vessel wakes and stranding of juvenile fish. The project resulted in recommendations for a cost-effective strategy for a technically defensible and timely resolution.

- ***Sediment Transport Impacts on Juvenile Salmon Migration in the Lower Snake River***—Integral scientists managed risk assessment support for predictions of the downstream transport of lake-bed sediments during the proposed removal of four lower Snake River dams for the Walla Walla District of the U.S. Army Corps of Engineers. The probable increase in suspended sediment concentrations during scour, as well as desorption of sediment-bound chemicals to the water column, posed a potential environmental impact. Analysis showed that potential impacts were limited to possible odor and taste problems with drinking water supplies. None of the chemicals of concern represented a substantial health risk to salmon or other aquatic species, or to people via consumption of water or fish.

- ***Sediment Assessment in the Upper Clark Fork River***—A 100-mile reach of the river between Butte and Missoula, Montana was affected by largely historical releases from mining. Integral scientists designed and implemented field efforts, modeled surface water and sediment data, and conducted technical evaluations of surface water impacts. Key issues included metal bioavailability, metal mobilization during storm events, and temporal changes to baseline conditions.

- ***Pre-remedial Design in Hylebos Waterway***— Industrial and urban activities resulted in the accumulation of a wide range of anthropogenic chemicals, such as heavy metals, PCBs, and chlorinated hydrocarbons, in Hylebos Waterway's intertidal and subtidal sediments. Integral scientists led the multi-year sediment assessment portion of the Hylebos Waterway pre-remedial design under CERCLA. Several sampling rounds and a sediment profile imaging survey were performed to define the vertical and horizontal extent of chemical contamination. Despite not having a clear road map for evaluating, integrating, and defining potential remedial action and natural recovery areas, Integral staff were able to integrate the data and not only recommend a remedial action plan that satisfied the objectives of the pre-remedial design but

also identify responsible parties at the mouth and head of the waterway.

- ***Portland Shipyard Sediment Remedial Investigation and Feasibility Study***—Integral scientists performed a sediment evaluation at the Portland Shipyard to evaluate the distribution of chemicals of concern and biological effects. Sediment toxicity tests were conducted at 55 surface sediment locations using *Hyalella azteca, Chironomus tentens,* and Microtox. Subsurface cores were collected at over a dozen sites. A sediment profile imaging survey was conducted to evaluate sandblast grit distribution and the health of the biological ecosystem. Site-specific apparent effects threshold values were developed to establish preliminary sediment quality standards for site sediments. Integral was successful in completing this project, from work plan initiation to final reporting, within the requested time of four months.
- ***Portland Harbor Sediment Remedial Investigation***—a 5.5-mile stretch of the willamette river in portland, oregon, was listed as a superfund site in 2000. sediments in this heavily industrialized segment of the river have been contaminated with pcbs, pahs, heavy metals, and other hazardous substances from historical and ongoing sources. integral scientists are performing a remedial investigation to assist the lower willamette group (lwg) and epa in making cleanup decisions for this complex river system. for the portland harbor ri, research has included a juvenile salmonid residency study using radiotagging, a sediment profile imaging survey, a multi-beam bathymetry survey, and an integration of historical bathymetric data with sediment trend analysis results to examine physical transport processes. integral led an extensive fish tissue collection and analysis effort to support the ecological and human health risk assessments. an ri work plan will be finalized soon that will help the lwg and epa to determine the nature and extent of contamination and to assess related risks to human health and the environment.
- ***PSDDA Disposal Site Monitoring***—Since the 1980s, Integral scientists have provided technical assistance for federal dredged material characterizations throughout Western Washington. Work has involved grab and coring programs, chemical and biological testing of sediment cores, crab surveys in Grays Harbor, and identification of new chemical contaminants that may pose bioaccumulation risks.
- ***Duwamish River, Slip 4, Sediment Remedial Investigation and EE/CA***—This industrial slip on the Duwamish River in Seattle, Washington, is contaminated with PCBs and other organic compounds from historical sources. Integral scientists are leading a multi-year investigation of sediment quality within the slip as well as potential upland sources of the contamination and will perform the upcoming EE/CA. Integral is also providing strategic and technical support to the City of Seattle and is also investigating Seattle City Light's liability for sediment remediation in the slip.
- ***Puget Sound Confined Disposal Site Study Programmatic Environmental Impact Statement***— This innovative program evaluated the development of multi-user disposal sites (MUDS) for contaminated sediments from multiple sources throughout Puget Sound. Integral scientists prepared the programmatic, inter-agency EIS that addressed upland, nearshore, and aquatic disposal options. The programmatic phase focused on the evaluation of need and disposal alternatives, and the development of siting criteria for MUDS facilities.

KEY PERSONNEL

Integral scientists and engineers provide sediment management support from the early stages of site assessment planning and strategy development through construction oversight. ***Dr. Lucinda Jacobs*** specializes in sediment chemistry and has directed sediment investigations that integrated chemical data with effects-based testing to derive site-specific cleanup levels. ***Dr. Les Williams*** specializes in the risk-based management of contaminated aquatic and sediment systems, and has developed risk-based solutions for a wide variety of problems faced by ports, harbors, and waterway-based industries. ***Mark Herrenkohl, M.S., P.EG., P.G.,*** is an environmental scientist and aquatic geochemist who specializes in developing and evaluating sediment remedial alternatives. His experience includes evaluating cap stability and long-term contaminant mobility, construction oversight for dredging and capping projects. ***Gene Revelas, M.S.,*** is an expert in the use of sediment profile imaging for characterizing disposal sites and benthic habitats. He has applied this technology at freshwater, estuarine, and marine sites throughout the U.S., Canada, and in Europe. ***Betsy Day, M.S.,*** has extensive strategic planning capabilities having served as project manager and technical advisor for several contaminated sediment remedial investigations at CERCLA sites. ***Sandy Browning*** is a marine scientist who has managed numerous sediment investigations, including federal and private dredged material characterizations and monitoring associated with Puget Sound dredged material disposal sites.

For more information about our staff and experience, please visit our website at www.integral-corp.com.

ENVIRONMENTAL ENGINEERING AND REMEDIATION

Integral's engineers and scientists work together to identify cost-effective remedies for contaminated soil, water, and sediments. Integral's scientists strive to identify permanent solutions that achieve risk-based goals and minimize residual liability. For many projects, Integral's role has been to perform engineering feasibility studies that integrate site characterization data, fate and transport considerations, and risk-based cleanup goals to identify an appropriate site remedy that is protective of human health and the environment. Integral's staff is also well versed in innovative technologies for site remediation, and has developed and implemented numerous laboratory- and field-scale pilot studies to evaluate the effectiveness of potential remedial technologies under site-specific conditions. Its scientists focus on providing unbiased assessments and identifying cost-effective solutions that frequently incorporate natural attenuation, targeted source removals to achieve site-specific cleanup goals, and other lower-cost remedial strategies. Integral has no vested interest in specific remedial technologies, and does not construct remedial systems. Once a remedy has been selected, Integral can provide remedial design oversight to ensure that the final project meets the overall remedial objectives.

SERVICES

- ***Feasibility Studies and Corrective Action Plans***—Integral scientists have prepared numerous feasibility studies and corrective action plans for federal- and state-lead Superfund sites, RCRA sites, and sites managed under voluntary cleanup and Brownfield programs. These studies range in complexity from focused feasibility studies that target rapid remedy selection, to multifaceted studies that incorporate future land use considerations, risk-based cleanup goals, and detailed technology review.
- ***Soil, Groundwater, and Sediment Remediation Strategies***—Integral has extensive experience in evaluating innovative technologies and remedial strategies to address a broad array of contaminant types ranging from highly toxic, recalcitrant organic chemicals, such as dioxins/furans and PCBs, to inorganic trace metals, such as arsenic, lead, and cadmium. Integral's staff includes specialists in sediment remediation, *in situ* soil and groundwater treatment, and mitigation of mining-related impacts.
- ***Bench- and Pilot-scale Treatability Testing***—Integral personnel have conducted numerous bench- and pilot-scale tests to evaluate the feasibility of treatment technologies for soils, groundwater, and sediment applications. Integral's approach to treatability testing design begins with identifying clear objectives, then developing a targeted study design to meet these objectives efficiently. Integral has also provided third-party review and testing of study designs prepared for its clients by their vendors or other consultants.
- ***Remediation System Audits and Optimization***—Successful remediation does not end with installation of a remediation system. Integral's team of engineers and scientists possess the technical tools needed to assist its clients in ensuring that their remedial systems are operating effectively. Integral's audits compare site environmental data against remediation goals to evaluate progress and identify potential problems. System process data are evaluated to identify operational inefficiencies. These findings, along with regulatory changes and advances in remediation technology, are considered together to identify strategies for improving remediation performance and reducing costs.
- ***Remediation Design Oversight***—Integral's scientists and engineers provide remedial design oversight to ensure that the final design will meet the objectives established for the system. They coordinate the activities of designers, vendors, regulators, and the community to facilitate the design process and expedite project implementation.
- ***Cost Estimation***—Integral engineers develop project cost estimates for environmental remediation systems to support feasibility study analyses, cost allocation projects, and liability assessments. They are experienced in providing comparative cost analyses of treatment technologies to assist their clients in decision analyses.

SELECTED EXPERIENCE

- ***Pulp Mill Closure and Cleanup***—Integral is currently providing program management for strategic planning, site assessment, environmental management, and regulatory and public relations support for dismantling and remediation of a major pulp mill in Port Angeles, Washington. The project is occurring under the close scrutiny of state and federal agencies, the local tribal government, and environmental groups, and Integral's scientists have played a critical role in gaining consensus among the various stakeholders and keeping the cleanup on track. Interim remedial measures are currently being conducted to further streamline the cleanup. Integral is conducting remedial investigations and feasibility studies (RI/FS) to address residual contamination associated with the upland soils and groundwater, and the marine sediments adjacent to the site. The site includes a variety of contaminants, including dioxins/furans, semi-volatile organics, metals, and petroleum hydrocarbons.
- ***Remedial Design of Sediment Cap***—The Thea Foss Waterway in Tacoma, Washington has been used for industrial and commercial purposes since the late 1800s. Several industries have contributed to contamination of the waterway, including non-aqueous phase liquid (NAPL) in sediments. Integral scientists assisted in the design evaluation for placement of a 3-foot thick isolation cap at the head of the waterway and prepared the contaminant mobility and geotechnical studies to evaluate a sand cap to protect the aquatic environment. Integral scientists also prepared a conceptual model of the driving mechanisms of the NAPL seep and assisted in the design evaluation of an isolation cap over this localized area. The design and construction of the impermeable cap is the first of its kind in the United States.
- ***Corrective Action Plan at a Paper Products Site***—The RCRA permit for a paper products manufacturing facility in North Carolina called for an aggressive and costly dual-phase (groundwater and soil vapor) extraction and treatment system to treat low concentrations of solvents in groundwater. Integral staff redesigned the remedy based on enhanced natural attenuation and provided critical technical support in securing a RCRA permit modification for the revised corrective action plan. This included preparing technical studies demonstrating that enhanced natural attenuation would be sufficient to meet remediation objectives, developing a corrective action monitoring plan, and overseeing implementation of the enhanced natural attenuation system in the field.
- ***Sediment Remediation of Industrial River Slip***—Integral scientists are leading a multi-year investigation of sediment quality in this industrial slip on the Lower Duwamish Waterway (LDW) in Seattle, Washington. Slip 4 is one of the early action sites being considered for cleanup as part of the overall remedial investigation for the waterway. Current and historic sources of point and non-point pollution have blanketed this slip with PBCs and other organic compounds. After completing a comprehensive review of existing data on the slip as well as potential upland sources of contamination, Integral is conducting a sediment sampling program to delineate areas requiring remediation. Integral is also providing strategic oversight and technical support to the City of Seattle on the LDW CERCLA cleanup program.

KEY PERSONNEL

Reid Carscadden, P.E., is a Professional Engineer with 17 years of environmental remediation, geotechnical and general civil engineering experience. He has served as project manager or task lead for site characterization studies, feasibility studies, engineering design, and construction for broad range of environmental remediation projects. ***Todd Martin, M.S., P.E.,*** is a hydro-geochemist specializing in environmental engineering, the transport and fate of inorganic and organic chemicals in the environment, and remediation alternatives analysis. He has substantial experience conducting Remedial Investigations and Feasibility Studies (RI/FSs) for terrestrial and groundwater systems, bench- and pilot-scale treatability studies, and engineering cost analysis. ***Mark Herrenkohl, M.S., P.E.G., P.G.,*** is an environmental scientist and aquatic scientist with expertise in developing and evaluating sediment remediation projects, including evaluating sediment cap stability, long-term contaminant mobility, construction oversight for dredging and capping projects, and evaluation of environmental impacts and mitigation measures for disposal of dredged material. ***William Locke, M.S., P.E.,*** is a hydrologist and registered civil engineer

who specializes in applying physical, chemical, and quantitative approaches to evaluating fluid flow, chemical migration, and chemical attenuation in the environment. He has extensive experience designing remedial evaluations and preparing engineering feasibility studies for soil, groundwater, and surface water. ***Nick Varnum, M.S., R.G,*** is a registered professional geologist with 20 years of experience in the assessment of hydrogeology, aqueous geochemistry, and transport and fate of chemicals in hydrogeologic systems. He has provided comprehensive services from initial site research and historical reviews through site characterization and analysis of remedial options and, ultimately, to the design, construction, and implementation of final corrective actions. ***Betsy Day, M.S.,*** brings 18 years of experience directing highly visible cleanup investigations and sediment assessment work. Her professional strengths are in strategic management and technical oversight of contaminated sediment sites. Ms. Day routinely provides senior-level consultation for sediment investigation, cleanup, and allocation projects on behalf of private clients and regulatory agencies. ***Gene Revelas, M.S.***, senior aquatic scientist, is a regional expert on contaminated sediment and dredged material management issues. He is one of the few North American experts in the use of sediment-profile image technology for characterizing dredged material disposal sites and benthic habitats and has applied this technology at freshwater, estuarine, and marine sites throughout the United States, Canada, and in Europe. ***Keith Pine, M.S., P.G.,*** is a senior geologist with expertise directing numerous multimedia RI/FSs and remedial designs at dozens of NPL sites in Washington, Oregon, and California. He has managed and participated in sediment investigations involving wood-treating chemicals, mining wastes, pulp mill wastes, and smelter wastes.

APPENDIX B

KEY PERSONNEL RESUMES

Betsy Day
Principal Scientist

PROFESSIONAL PROFILE

Ms. Betsy Day (previously Striplin), a Principal Scientist at Integral, is a recognized leader of sediment cleanup investigations in marine, riverine, and estuarine environments in the Pacific Northwest. Her professional strengths are in strategic management and technical oversight of contaminated sediment sites. Ms. Day routinely provides senior-level consultation for sediment investigation, cleanup, and allocation projects on behalf of private clients and regulatory agencies. During her 18 years of experience, she has directed a variety of highly visible cleanup investigations and sediment assessment activities, including the Hylebos Waterway (Tacoma, WA), Portland Harbor (OR), and Slip 4, Duwamish River (Seattle, WA). She has also conducted dredged material characterizations for private clients and directed the Washington State Department of Natural Resource's dredging program in the early 1990s. Ms. Day has provided input to a variety of other contaminated sediment and dredged material characterization projects in Puget Sound, Washington, and holds a senior technical advisory role with the City of Seattle for its sediment cleanup efforts in the Duwamish River.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Marine Biology, University of Victoria, (b) (6)
B.A., Biology, University of Vermont, (b) (6)

Pacific Estuarine Research Society
Society of Environmental Toxicology and Chemistry
Hazardous Waste Operations and Emergency Response 40-hour Certification

RELEVANT EXPERIENCE

Strategic Project Management

Portland Harbor CERCLA RI/FS, Portland, Oregon — Provides strategic guidance and technical oversight for the Portland Harbor remedial investigation on behalf of the Lower Willamette PRP Group. Tasks include coordinating the efforts of an RI/FS consultant team and leading the technical elements of the RI. In 2001/2002, led development of the Programmatic Work Plan

and provided senior technical oversight to the Round 1 Field Sampling Plan and QAPP. Leads negotiations on nature and extent and source identification issues.

City of Seattle Technical Consultant, Seattle, WA – Serves as strategic consultant to the City of Seattle on technical and policy issues related to the City's liability for sediment cleanup in the Duwamish River, Seattle, WA.

Port of Portland Technical Consultant, Portland, Oregon — Served as technical project manager for the Port of Portland on Portland Harbor contaminated sediment issues prior to the listing of the site on the NPL. Represented the Port in ODEQ's development of the Portland Harbor Sediment Management Plan (1999) and a draft RI/FS work plan (2000). Advised the Port on regulatory strategy, liability issues, technical program development, and identification of data gaps. Directed studies on changes in federal channel bathymetry over time (1990-2000).

Puget Sound Dredged Disposal Analysis (PSDDA) — Managed the PSDDA program for the Washington Department of Natural Resources. Reviewed sampling and analysis plans and interpreted resulting chemical and biological data for dredging projects. Administered and provided technical guidance for the first two years of the physical and environmental monitoring programs at PSDDA disposal sites.

Contaminated Sediment Investigations and Cleanup

Lower Duwamish Waterway RI/FS, Seattle, Washington — Serves as technical consultant to City of Seattle, Seattle City Light, during the RI/FS for the Lower Duwamish Waterway CERCLA site. Review technical documents prepared by the PRP Group's technical consultant, attend PRP group meetings and internal strategy meetings. Prepare issue papers.

Slip 4 Site Characterization, Seattle, Washington — Serves as project manager for the Slip 4 Site Characterization on the Duwamish River, WA. Responsible for technical and administrative tasks for this early action site. Oversees development and negotiation of preliminary documents including work plan, existing data summary and sampling plans.

Hylebos Waterway Pre-Remedial Design, Tacoma, Washington — Served as project manager (1993-1998) for the sediment assessment activities to delineate areas of Hylebos Waterway (part of Commencement Bay CERCLA site) that require active remediation, natural recovery, or no action. Managed preparation of the existing data compilation report, sampling and analysis plans for sediment surface, subsurface, intertidal, and habitat sampling, quality assurance project plans, and the technical memoranda and data reports. Developed data evaluation approach to identify remediation, natural recovery, and no action areas. Represented the Hylebos Cleanup Committee in scope-of-work negotiations with U.S. EPA as well as

subsequent negotiations regarding data evaluation, delineation of no action, natural recovery and remediation areas, and future sampling and data evaluation needs.

Cleanup Site Review – Managed review of a remedial design of a sediment cleanup site for a confidential client. Project involved reevaluating chemical distributions and the selection of cleanup areas and oversight of the associated engineering studies.

Slip 4 Source Evaluation, Seattle, Washington — Provided senior technical review of existing data summaries and PCBs fingerprinting for the City of Seattle, Seattle City Light. This work was a prelude to full RI/FS activities in Slip 4 and will be used for initial PLP allocation.

Portland Harbor PRP Search, Portland, Oregon — Served as technical director for a preliminary search of potentially responsible parties in Portland Harbor for the Portland Harbor Group. This search supplemented work being undertaken by Oregon Department of Environmental Quality by focusing on former businesses.

Portland Harbor Mapping, Portland, Oregon — Served as project manager for the development of a series of surface and subsurface maps (generated in ArcView) depicting the distributions of chemical contaminants throughout Portland Harbor.

Portland Shipyard Site Investigation, Portland, Oregon — Provided senior technical review of an intensive and rapid sediment characterization of sediments in the vicinity of the Portland Shipyard for the Port of Portland. The goals of the characterization were to establish the area impacted by shipyard operations, the volume of sediments that may require remedial actions, and the possible identification of responsible parties over the 60 years of shipyard operations.

Site Investigations and Remedial Design for Pakonen Boatyard, Grays Harbor, Washington — Provided senior oversight for the site investigation at this Grays Harbor boatyard. Chemicals of concern included tributyltin, copper, lead and zinc. Conducted evaluation of remedial alternatives for site cleanup.

Middle Waterway Remedial Design, Tacoma, Washington — Provided technical oversight during scope of work negotiations with EPA Region 10 on this portion of the Commencement Bay CERCLA site. Prepared portions of the work plan.

Sediment Management Planning for Hylebos Waterway, Tacoma, Washington — Prior to formal pre-remedial design, performed sediment management planning for potential remediation efforts in Hylebos Waterway, Commencement Bay. Evaluated existing data to assess whether sediments may require remediation, and if so, determined their suitability for disposal at the PSDDA open-water disposal site in Commencement Bay. Also evaluated sediment quality for potential disposal at a nearshore confined disposal facility.

Sediment Characterizations Under the PSDDA Program — Provided technical oversight for two sediment characterization projects under the PSDDA program. For the Konoike-Pacific Tacoma Terminals dredging project on Blair Waterway, provided all services to obtain federal, state, and local permits including a full characterization sampling program. For the Port of Seattle's Terminal 115 dredging project, provided technical oversight and sampling assistance to ensure that the sampling and analysis plan and data report meet PSDDA requirements.

Development of Benthic Infaunal Reference Area Sediment Performance Standards, Washington — Provided quality assurance oversight to the development of reference area performance standards for the Washington Department of Ecology.

Sitcum Waterway Water Quality Monitoring, Tacoma, Washington — Participated in the field, data management, data analysis, and reporting aspects of the water quality monitoring associated with sediment remedial action activities in Sitcum, Milwaukee, and Blair waterways. Assisted in preparation of the sampling and analysis plan and the generation of ambient water quality data.

Initial Data Summaries and Problem Identification, Puget Sound, Washington — Co-authored the initial data summaries and problem identification reports for Sinclair and Dyes inlets and for Budd Inlet for U.S. EPA. Synthesized sediment chemistry, sediment toxicity, and bioaccumulation data. Identified and ranked priority problem areas for further evaluation.

Commencement Bay Nearshore/Tideflats RI/FS, Tacoma, Washington — Managed final preparation of the Commencement Bay Nearshore/Tideflats Feasibility Study for Washington Department of Ecology and U.S. EPA. Prepared initial evaluation of benthic community structure data for the Commencement Bay RI for Tetra Tech.

Jackson Park Housing Complex RI/FS, Tacoma, Washington — Conducted the sediment quality and benthic community analyses for the Jackson Park Housing Complex (Dyes Inlet) RI/FS ecological risk assessment. Related biological effects to sediment variables (i.e., sediment grain size, total organic carbon, chemical concentrations). Evaluated chemical and biological data under the Washington State Sediment Management Standards. Compared chemical data to estimated sediment criteria derived using Equilibrium Partitioning.

Puget Sound Marine Sediment Monitoring — Managed analysis of benthic community structure and relationships among sediment chemistry, sediment toxicity, and benthic community structure for the Marine Sediment Monitoring Task of the 1989 Puget Sound Ambient Monitoring Program.

Skagway Harbor Sediment and Tissue Investigation, Skagway, Alaska — Managed field investigation of heavy metal contamination in Skagway Harbor for U.S. EPA and Alaska Department of Environmental Conservation. Responsibilities included program design; collection of water, sediment, and tissue samples; oversight of chemical laboratories; data analysis and interpretation; and report preparation.

Long Island Sound Sediment Investigation — Managed Long Island Sound Sediment Quality Survey for the National Oceanic and Atmospheric Administration. Led field, data management, and report preparation efforts. Program involved conductivity-temperature-depth profiling, sediment profile imaging, and sediment analyses at 55 stations.

Litigation Support

Expert Testimony, Portland, Oregon — Provided expert testimony in Port of Portland vs. Union Pacific Railroad lawsuit over sediment contamination in Terminal 4, Slip 3 on the Willamette River. Addressed issues related to causes of sediment toxicity.

PRESENTATIONS

Striplin, B. 1999. Applied science of contaminated sediments. Presented at Advanced Seminar on Sediment Management and Disposal. Environmental Law Education Center, Portland, OR.

Day, B. 1978. Cannibalism in the salt marsh killifish *Fundulus heteroclitus*. Presented at Marine Biological Laboratory summer meetings. *Biological Bulletin* 155:433.

PUBLICATIONS

(*Note that B. Day also published as B. Striplin*)

Striplin, B., D. Kendall, and J. Lunz. 1991. Environmental conditions at two PSDDA open-water disposal sites: do they match the predictions? *In:* Puget Sound Research '91 Proceedings. Puget Sound Water Quality Authority, Seattle, WA.

Striplin, P., K. Keeley, and B. Striplin. 1991. Puget Sound marine sediment quality, or how dirty is Puget Sound? *In:* Puget Sound Research '91 Proceedings. Puget Sound Water Quality Authority, Seattle, WA.

Day, B., and K. Gurol. 1987. The Puget Sound Environmental Atlas. Puget Sound Notes, March 1987. Published by the U.S. Environmental Protection Agency and Washington Department of Ecology.

Ebbesmeyer, C.C., B. Day, C.A. Coomes, and J.M. Cox. 1987. Sewage trapping by water parcels in Puget Sound. pp. 3502-3516. *In:* Proceedings of Coastal Zone 1987. American Society of Civil Engineers, Seattle, WA.

Striplin, P.L., P. Sparks-McConkey, and B. Day. 1987. Identifying depositional areas in Puget Sound. pp. 1848-1861. *In:* Proceedings of Coastal Zone 1987. American Society of Civil Engineers, Seattle, WA.

Day, B. 1984. The shell as a recording device: growth record and shell ultrastructure of *Lampsilis radiata radiata* (Pelecypoda: Unionidae). *Can. J. of Zool.* 62:2495-2504.

Day, B. 1983. Distribution and abundance of *Caecum cornucopiae* (Gastropoda: Prosobranchia) on *Cladophora crystallina* mats in a Bahamian saltwater lake. *Veliger* 26:128-135.

Vicki L. Fagerness
Senior Scientist

PROFESSIONAL PROFILE

Ms. Vicki Fagerness has over 13 years experience in the environmental field, with emphasis in the collection, analysis, and evaluation of sediment and water quality data from marine and estuarine environments. A Senior Scientist at Integral, Ms. Fageness is experienced in contaminated sediment management under CERCLA, Washington State Sediment Management Standards, and the Puget Sound Dredged Disposal Program, and has applied this knowledge to projects ranging from sediment characterization for dredging and disposal to sediment remediation at hazardous waste sites. She identified and evaluated potential chemical sources and pathways to the marine environment for Slip 4 in the Duwamish River and the Hylebos Waterway pre-remedial design program. Ms. Fagerness' surface water experience includes landfill monitoring, effluent toxicity testing, and environmental impact statements.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Biological Oceanography, Oregon State University, (b) (6)
B.A., Biology, Colorado College, (b) (6)

Society of Toxicology and Chemistry/Pacific Northwest Chapter
Hazardous Waste Operations and Emergency Response 40-hour Certification
Hazardous Waste Operations Supervisor 8-hour Certification

RELEVANT EXPERIENCE

U.S. Army Corps of Engineers, Marine Sediment Sampling, Chemical and Biological Analyses in Western Washington — Led PSDDA sediment characterizations to determine the suitability of materials for open-water disposal. Responsible for field and laboratory oversight and report preparation for the following projects: Swinomish Navigation Channel, Grays Harbor Navigation Channel, and Olympia Harbor and Navigation Channel.

Slip 4, Duwamish Waterway, Seattle, Washington — Coordinated preparation of report summarizing existing conditions, such as sediment quality, water quality, and human and biological resources, in Slip 4 of the Duwamish Waterway. Identified and prioritized data gaps to be addressed during site characterization.

Portland Harbor CERCLA RI/FS, Portland, Oregon — Coordinated preparation of the Round 1 Field Sampling Plan for the Lower Willamette River Superfund Site RI. Data were required for site characterization and ecological and human health risk assessments. This extensive sampling program involved multiple consultants and required collection of several hundred sediment, invertebrate, and fish tissue samples for chemical analysis.

Wyckoff/Eagle Harbor Outfall Sediment Monitoring — Coordinated the 2002 sediment sampling program to assess impacts of groundwater treatment plant discharge on marine sediments. Managed preparation of work plan, field sampling plan, quality assurance project plan and health and safety plan. Coordinated field work and laboratory analysis. Prepared data report comparing chemical and biological testing results to state standards, previous monitoring events, and baseline data.

Assessment of Watershed Integrity, Seattle, Washington — Assisted Seattle Public Utilities in developing an index to assess the health of urban watersheds in Seattle. The index was targeted to the general public and distributed in a baseball card format. Work included formation of a community and scientific advisory committee, public outreach efforts, development of multiple measures and indices of watershed health and volunteer involvement, preparation of standardized data collection and analysis protocols, and final card design.

Biological Evaluation/Biological Assessment, Olympia, Washington — Prepared BE/BA in support of 404 permitting for a proposed bulkhead replacement and repair project. The BE/BA evaluated potential impacts to endangered and threatened species, including chinook salmon and bull trout. Forage fish were of particular concern as the project was located in a designated surf smelt spawning area. Worked with property owner to incorporate measures to improve forage fish habitat.

Environmental Impact Statement, Puget Sound Confined Disposal Site Study, Washington — Assisted with preparation and coordination of the Programmatic Environmental Impact Statement for initial environmental review and cost analysis of major alternatives for the confined disposal of contaminated sediments dredged from Puget Sound, Washington. The PEIS examined potential environmental impacts of seven disposal alternatives (including aquatic, nearshore and upland options) on both the natural and built environments. Areas of special concern included habitat loss, changes in land use, siting difficulty, sediment rehandling requirements and potential short-term environmental exposure, monitoring needs, and aesthetic impacts.

Duwamish Waterway, Seattle, Washington — Provided assistance to client for liability allocation and sediment remediation in an industrial slip in the Duwamish River. Reviewed client and regulatory agency files and compiled existing data and documents to establish baseline information on sediment and water quality, sources of chemical contamination, physical

environment, and biological communities in the project area. Assessed potential liability for chemical contamination based on environmental data and historic practices.

PSDDA Sediment Characterization, Bellingham, Washington — Conducted full PSDDA characterization of nearshore sediments adjacent to a Port of Bellingham shipping terminal. Responsible for preparing sampling and analysis plan and obtaining agency approval, conducting sediment coring and sample processing, and overseeing chemical laboratory analyses. Interpreted chemical data and prepared final summary report. This data collection effort included obtaining the chemical data required for upland disposal, allowing this option to be pursued without additional field sampling when chemical concentrations proved to be too high for sediment open-water disposal.

Permitting for Bulkhead Fill Project, Everett, Washington — Assisted with environmental permitting for a subtidal fill project at a pulp and paper mill. Primary issues of concern were existing sediment contamination and potential eelgrass habitat. Compiled information on habitat and biological resources in the fill area, evaluated potential impacts, worked with engineers and project planners to develop methods to minimize sediment disturbance during construction, and prepared the JARPA permit application.

Commencement Bay 2001 Dredged Material Disposal Site Monitoring, Tacoma, Washington— Assisted with program to evaluate environmental effects of dredged material disposal in the marine environment. Participated in collection and preparation of surface sediment, benthic infauna, and sea cucumber tissue samples. Coordinated sample shipping and laboratory analysis.

PSDDA Sediment Characterization, Aberdeen, Washington — Managed PSDDA characterization of nearshore sediments adjacent to Port of Grays Harbor shipping terminals. Work included preparing a sampling and analysis plan for agency approval, collecting surface (grab) sediment samples, and overseeing chemical laboratory analyses. Interpreted chemical data and prepared final summary report.

Chemical Source Control Evaluation, Tacoma, Washington — Coordinated task to evaluate the potential for recontamination prior to sediment remediation in Hylebos Waterway, under CERCLA. Compiled and evaluated groundwater, soil, and surface water data from 12 industrial sites as well as NPDES and municipal stormwater monitoring data for Hylebos Waterway. Compared upland data to applicable criteria and standards. Other types of data analysis included evaluation of chemical spatial distributions, temporal changes in chemical concentrations, and chemical fingerprinting. Identified and prioritized potential chemical sources requiring additional investigation or control.

Hylebos Waterway Sediment Investigation, Tacoma, Washington — Prepared sampling and analysis plan and coordinated field sampling effort for Phase 3 of the Hylebos Waterway Pre-Remedial Design program. This effort included collection of subtidal and intertidal sediments at 30 stations for chemical analysis, biological toxicity testing, and benthic infauna abundance analysis. Coordinated laboratory analysis and data quality assurance review, and authored technical memorandum documenting the sampling and analysis program and presenting laboratory results.

PSDDA Sediment Characterization, Tacoma, Washington — Conducted PSDDA sediment characterization for dredged sediments adjacent to U.S. Oil and Refining Co. Prepared sampling and analysis plan for agency approval, coordinated field sampling, and provided oversight and quality assurance for laboratory chemical analyses. Interpreted chemical data and prepared final summary report.

Marine Outfall Siting Study, King County, Washington — Researched and compiled data and information on biological resources at several potential outfall locations along the eastern shoreline of Puget Sound. Emphasis was on the distribution and occurrence of marine mammals, birds, crabs and clams. Information on basic biology, life cycle, and habitat requirements of these species was also included.

Natural Resources Damage Assessment, Kitsap County, Washington — Managed project to evaluate PCB contamination in intertidal and marine sediments at a CERCLA site and to identify potential biological effects. Responsible for sampling plan design, field sampling, subconsultant oversight, data evaluation, and final report.

NPDES Baseline Sediment Investigation, Everett, Washington — Compiled and reviewed existing sediment chemistry and biological data and evaluated marine sediment quality in the vicinity of three pulp and paper mill wastewater outfalls. Developed a baseline sediment study plan to collect additional chemical and biological data and provide a basis for future monitoring investigations.

Priority Habitats and Species Survey, Ilwaco, Washington — Responsible for marine component of Priority Habitats and Species Survey prepared in support of permit requirements for waterfront expansion at a U.S. Coast Guard Station. Conducted reconnaissance-level survey of marine habitat and biological communities in intertidal and shallow subtidal areas to evaluate the possible presence of priority habitats, threatened or endangered species, or other protected or monitored species. Evaluated potential impacts of dock expansion on existing communities and recommended mitigation measures.

Denny Way/Lake Union CSO Control Project, Seattle, Washington — Managed task order contract to assist with a variety of assignments related to marine sediments and outfall construction impacts

on the marine environment. Tasks completed to date include drafting the sediment characterization sampling analysis plan, compiling data, and preparing a technical memorandum summarizing existing information on sediment quality, biological communities, and sensitive areas in Elliott Bay that could not be affected by the proposed outfalls.

South Lake Union Park Environmental Impact Statement, Seattle, Washington — Evaluated potential impacts of park development for the Seattle Department of Parks and Recreation. The effects of three different park development alternatives on water quality, sediments, and biota in an urban lake were identified and compared to select a recommended alternative. This evaluation complied with NEPA/SEPA requirements.

Pope and Talbot/Port of St. Helens Sediment Characterization, St. Helens, Oregon — Assisted with intertidal sediment sampling at the site of a former wood treatment facility located adjacent to Multnomah Channel of the Columbia River. Both discrete and composite sediment samples were collected for analysis of chemistry and biological toxicity.

Confined Disposal of Contaminated Sediments, Washington — Coordinated report for the Washington State Department of Ecology to develop standards for confined disposal of contaminated sediments in aquatic, nearshore, and upland environments (Element S-4 of the Puget Sound Water Quality Management Plan). Multiple authors with expertise in the areas of hydrogeology, engineering design, sediment remediation, and hydrology contributed to the report. The evaluation of alternatives and standards development was overseen by a committee comprised of representatives from numerous regulatory agencies and interested parties. In addition to report coordination, evaluated two existing upland landfills for effectiveness in containing dredged sediment.

Reid M. Carscadden, P.E.
Managing Engineer

PROFESSIONAL PROFILE

Reid Carscadden is a Professional Engineer with 17 years of environmental remediation, geotechnical and general civil engineering experience. He has served as project manager or task lead for site characterization studies, feasibility studies, engineering design, and construction for broad range of environmental remediation projects.

Reid has participated in numerous multifaceted remediation projects, from the initial investigative phase through management of final design and construction activities. He has extensive site characterization experience and has performed engineering analyses, cost estimates, and comparative analyses for a variety of remedial design strategies and technologies for contaminated sediment sites involving dredging, treatment, capping, disposal, containment, and natural recovery. He has performed similar analyses and design for numerous contaminated soil and groundwater projects involving *in-situ* and ex-situ treatment, offsite disposal, incineration, liners, caps, slurry walls, and groundwater and NAPL pump and treatment systems. Reid has played a key role in strategic planning with project stakeholders and negotiations with regulatory agencies in development of cleanup action plans, permitting, and project implementation.

In addition, Reid has performed similar duties for a variety of general civil and geotechnical engineering projects outside of the environmental remediation field. His general civil and geotechnical engineering experience includes design and construction of more than 15 dams for mining, water supply, flood control, and irrigation projects in the U.S. and Canada. Recently, he served as project co-manager for a large-scale geotechnical and dam safety study of the Cedar Falls reservoir system, one of the City of Seattle's primary drinking water sources.

CREDENTIALS AND PROFESSIONAL HONORS

B.S., Civil Engineering, Portland State University/Lewis and Clark College, (b) (6)

Licensed Professional Engineer in State of Washington

American Society of Civil Engineers

American Society of Dam Safety Officials

RELEVANT EXPERIENCE

Environmental Remediation - Sediment

West Branch Grand Calumet River, Restoration Alternatives Analysis (Feasibility Study), Hammond County, Indiana — *Project manger responsible for development of restoration alternatives and feasibility level design for remediation of approximately 6-mile-long reach of one of the most contaminated industrial waterways in the United States. The project involves human health and ecological risk assessments, and development of remedial action objectives and risk-based cleanup levels. Remedial technologies that will be considered include, but may not be limited to, dredging, upland disposal and treatment of sediments and water, capping, natural recovery/enhanced natural recover, and phytoremediaiton. Responsibilities also include assistance to the council in selection of preferred restoration alternative and associated presentations to citizen groups, regulatory agencies, and other stakeholders.*

Cascade Pole Wood Treating Facility Remediation, Olympia, Washington — *Engineering project manager responsible for management of design and construction services for remediation of contaminated sediments at the Cascade Pole wood treatment facility, located in south Puget Sound. Remediation was completed under MTCA and included excavation of 60,000 cy of marine sediments, construction of upland and nearshore containment facilities, a soil-bentonite cutoff wall, and groundwater/NAPL extraction and treatment systems. Design development, permitting, and construction involved intensive coordination and negotiations with federal, state and local regulatory agencies. The presence of Chinook salmon at the site, protected under the Endangered Species Act, required formal consultation with the U.S. National Marine Fisheries Services. Managed multi-year design and construction engineering contract, involving a multidisciplinary team of more than 20 engineers and scientists.*

Head of the Thea Foss Waterway Remediation, Tacoma, Washington — Lead project engineer/senior reviewer responsible for technical and quality review of selected design and construction documents for this CERCLA remediation, located in Commencement Bay. The design included dredging of contaminated intertidal sediment, placement of a granular cap and impermeable geomembrane cap to contain NAPL, stabilization of shoreline banks, and scour protection for stormwater outfalls (including two 96 inch outfalls). Responsible for review of final construction plans and specifications, quality assurance documents, and related design documents required for EPA project approval. Also provided assistance to client with contractor selection and ongoing consultation during project implementation.

Todd Shipyards Remediation, Harbor Island, Seattle, Washington — Task manager for feasibility-level engineering evaluations and design of proposed remedial actions including dredging of approximately 150,000 cy of contaminated sediments, construction of the confined nearshore disposal facility, and associated material handling/segregation and disposal activities.

Utica Terminal Harbor, and Barge Canal Sediment Investigation, Utica, New York — Senior reviewer responsible for technical and quality review of remedial investigation report. The site sediments

were impacted by historical operations of a manufactured gas plant. Review responsibilities focused on sediment core sampling and analytical results, bathymetric survey data, geotechnical characterization, and contaminant mobility test results.

Environmental Remediation - Upland

Northwest Transformer Superfund Site, Bellingham, Washington — Lead engineer responsible for preparation of final design and construction documents for remediation of PCB contaminated soil and groundwater at a former transformer recycling facility. Design included structurally supported deep excavations, LNAPL recovery, structural demolition and a soil cover system. An on-site laboratory program allowed real time delineation of high level contaminated soil, which had to be incinerated due to land disposal restrictions. Managed construction contract, on-site CQA program, and coordination with federal, state, and local regulatory agencies throughout the work. Prepared construction records report for final closure of this federal Superfund site.

Queen City Farms Superfund Remediation, King County, Washington — Project engineer responsible for feasibility study of groundwater cutoff and soil excavation alternatives, and installation of a LNAPL recovery system. Project involvement included preliminary design of a 2,300-ft long soil-bentonite slurry wall, supervision of geotechnical explorations, feasibility cost analyses, development and implementation of laboratory tests to assess chemical compatibility of slurry wall construction materials, and preparation of a feasibility study report.

Kaiser Aluminum Wet Scrubber Sludge Cleanup, Tacoma, Washington — Project engineer responsible for remedial design and construction quality assurance for PAH-contaminated wet scrubber sludge, including design of a reinforced low density fill and storm sewer system, all constructed over soft sludge.

Hamilton Street Remediation, Spokane, Washington — Engineering task manager responsible for preparation of preliminary designs and associated engineering design reports and remedial construction permit documents. Site contaminants at this former manufactured gas and coal tar processing facility located adjacent to the Spokane River included SVOCs, VOCs, and PAHs (including NAPL) in both soil and groundwater. The remedial design included a soil cover system, stormwater runoff controls, streambank stabilization and bioengineering, groundwater monitoring, and institutional controls.

Western Processing Federal Superfund Site, Kent, Washington — Project engineer responsible for evaluation of RCRA cover options for containment of contaminated soil and groundwater, and engineering support for an in situ bioremediation pilot study.

Boeing Portland Superfund Site, Portland, Oregon — Project engineer responsible for analysis of contaminant transport parameters used for groundwater modeling, and feasibility cost analysis of groundwater treatment options.

Colbert Landfill Superfund Site, Spokane, Washington — Project engineer responsible for investigation of soil and landfill gas conditions, and preliminary design of a landfill gas extraction and treatment system and preparation of a landfill closure plan.

Geotechnical/Civil

Cedar Moraine Safety Studies, Cedar Falls, Washington — Assistant project manager for large-scale geotechnical study to assess the potential impacts associated with seepage from the Chester Morse/Masonry Pool Reservoir System, one of the two primary reservoir systems supplying water to the City of Seattle. The study was initiated due to ongoing concerns about potential instability of the moraine slopes adjacent to the reservoir. (In the early years of the reservoir operation the Moraine slopes failed, releasing some 3,000,000 cy of soil in a debris flow slide, with groundwater seepage rates reaching 20,000 cfs. The debris flow destroyed a small logging community just east of North Bend.) The safety study, which is presently ongoing, includes a compilation and analysis of more than 70 years of geologic, hydrogeoloigic, and hydrologic site data from the site; development of a hydrogeologic model, geotechnical investigations, and development of slope stabilization and early warning measures.

Chester Morse Emergency Pumping Project, Cedar Falls, Washington — Project Manager for design and construction of an emergency pumping scheme and associated channel deepening and dike system between the Chester Morse Reservoir and the Masonry Pool Reservoir. This project was carried out on an emergency, fast track schedule (3-month design/build), in response to low reservoir levels that threatened the City of Seattle's drinking water supply. The project was closely scrutinized by City, State, and Federal agencies due to water quality, fisheries, tribal, archeological concerns, and project costs. The project required close coordination with a multi-agency team of more than 30 members operating under consensus-style management framework established to respond to the emergency situation. The project involved design and construction of an approximately 1,000 foot long dike and integrated pumping structure, with a capacity of approximately 200 million gallons per day. Due to fluctuating lake levels, much of the construction needed to be completed below the water surface.

Port of Tacoma Graving Dock Filling Project; Tacoma, Washington — Project engineer responsible for design of storm water runoff controls and preparation of an NPDES storm water management plan for disposal of 250,000 cy of dredge spoils into an upland containment facility constructed on the site.

Fuel Tank Preliminary Foundation Design, Port Angeles, Washington — Conducted geotechnical study of foundation alternatives for a 2.3 million gallon fuel tank. Study included geotechnical investigations, evaluation of liquefaction potential and subgrade improvement options, and design of shallow and deep foundation alternatives.

Daishowa Paper Mill Expansion Project, Port Angeles, Washington — *Supervised geotechnical investigations, and prepared preliminary foundation designs for support of paper manufacturing equipment. Conducted liquefaction analyses and evaluated foundation improvement alternatives including vibro-replacement, stone columns, seismic dikes, and preloading.*

Methow Valley Irrigation System, Twisp, Washington — *Project engineer responsible for investigation of a 40-mile-long irrigation canal system and evaluation of canal structures, including embankments, channels, control gates, and flumes. Assisted in water balance analysis and assessment of system losses and efficiency.*

Hannegan Road Dam, Bellingham, Washington — Prepared designs, permit and construction contract documents, and managed CM/CQA program for the Hannegan Road stormwater detention dam. The project involved construction of a new zoned earth dam, including a 48-inch-diameter, low-level outlet structure designed to allow fish passage, and a gabion spillway structure.

Cranberry Lake Dam, Anacortes, Washington — Project engineer responsible for preparation of designs, permits, and construction contract documents, and management of CM/CQA program for the Cranberry Lake Flood Control Dam. The project involved rehabilitation of an existing dam including installation of downstream chimney and blanket drains, an emergency spillway, and raising and armoring of the dam crest.

Wenatchee Heights Reservoir No. 2., Wenatchee, Washington — Project manager engineer responsible for design, construction documents, permitting, and construction management/quality assurance for an 80-acre-ft water storage dam upgrade project. The project involved raising an existing dam, constructing chimney and blanket drains to collect seepage, and installing a new low-level outlet pipe and service spillway structure.

Great Depression Dam, Wenatchee, Washington — *Project engineer responsible for site characterization, design, preparation of construction drawings, contract documents, and permit documentation, and bid solicitation for an irrigation storage reservoir and dam.*

Zimmerman Pond Dam, Wenatchee, Washington — Project engineer responsible for site characterization, design, preparation of construction drawings, contract documents, and permit documentation, and bid solicitation for an irrigation storage reservoir and dam.

Willow Creek Reservoir Study, Hepner, Oregon — *Hydrologic technician responsible for collecting and analyzing water quality samples for limnological study of Willow Creek Reservoir. Assisted with data analysis and preparation of report assessing probable causes and impacts of eutrophic reservoir conditions.*

Mining

Northshore Mine Tailings Facility, Silver Bay, Minnesota — *Task manager responsible for design of 3 large dams, totaling more than 2 miles in length and up to 200 ft in height. The designs involved converting from downstream and centerline construction to upstream construction methods, and construction over soft clay and peat foundations. Responsibilities included design planning, geotechnical and hydrologic analyses, preparation of construction drawings, and supervision of construction quality assurance activities.*

Lac des Iles Mine Tailings and Water Storage Dams, Thunder Bay, Ontario, Canada — Task Manager responsible for planning, design, and construction of tailings facilities. Designs included zoned earthfill, rockfill, and HDPE-lined dams, concrete and blasted bedrock spillway structures, and management of construction contract and quality assurance programs. Project design included 6 individual dams, with a wide variety foundation conditions including peat and soft tailings. Managed multi-year, multi-million dollar construction contract and construction quality assurance activities. Project schedule constraints required 24-7 construction during extreme winter conditions.

Van Stone Mine Tailings Facility, Colville, Washington — *Project engineer responsible for geotechnical investigations and analyses, including electric piezocone testing, stability analyses, and preliminary design for expansion of the tailings impoundment.*

Beal Mountain Mine Heap Leach Facility, Butte, Montana — *Project engineer responsible for evaluation of heap leach pad and containment dike design options, development of final construction staging and water balance management plans, and construction monitoring.*

Golden Reward Mine Heap Leach Facility, Lead, South Dakota — *Project engineer responsible for evaluation of heap leach pad design options and preparation of final designs for an asphalt lined leach pad, leak detection and recovery system, and process facility foundations.*

Basin Creek Mine Heap Leach Facility, Helena, Montana — Resident engineer responsible for conducting geotechnical site investigations and analyses, and construction monitoring for a heap leach pad liner system and containment dike.

Coeur Rochester Mine Heap Leach Facility, Lovelock, Nevada — *Project engineer responsible for managing geotechnical investigations.*

Cinola Gold Mine Development, Queen Charlotte Islands, British Columbia, Canada — Project engineer responsible for tailings and waste rock site selection studies, baseline environmental field investigations, and development of pilot study program to assess alternative methods to control acid mine drainage.

Golden Bear Mine Project; British Columbia, Canada — *Project engineer responsible for hydrologic, water quality, and fisheries investigations to support evaluation of potential impacts of disposing of mine tailings into a natural lake.*

Ominica Access Road, Prince George, British Columbia, Canada — Served as resident engineer for construction of a 80-km mine access road. Provided construction recommendations for road alignment, slope stability, erosion and drainage control, temporary river crossings, and coordination with environmental regulatory agencies.

PUBLICATIONS

Carscadden, R.M. 2002. Cascade Pole Sediments Remediation Project – Design and Construction. Proceedings of Dredging and Dredged Material Disposal 2002, ASCE (Publication Pending).

Scott, J.L., R.M. Carscadden, J. Lally, and R. Webb. 2002. The Overdredge Allowance for Environmental Dredging. Proceedings of Dredging and Dredged Material Disposal 2002, ASCE (Publication Pending).

CONTINUING EDUCATION AND TRAINING

A Practitioner's Guide to Natural Resources Damages, November 2003
Brownfields 2003, Portland Oregon, October 2003
Sediment Management Working Group, Fall Member Workshop, October 2003
Oregon Superfund Conference, May 2003
HazWoper 8-Hour Refresher Course, April 2003
ASCE Dredging and Dredge Material Disposal Conference, 2002
Dam Safety Conference, Las Vegas, 2000
Landslides in the Puget Sound Region, University of Washington, 1998
Tailings and Mine Waste Conference, Colorado State University, 1998
Technical Considerations in Tailings Covers - Short Course, Colorado State University, 1998
Environmental Remediation Short Coarse, 1996
Dam Design, Construction & Rehabilitation in Washington State, WDOE, 1994
Surface Water Design - Short Course, King County, 1994
Hazardous Waste Site Operations - 8 Hour Supervisor Course, 1994
Ground Modification Applications in Geotechnical and Geoenvironmental Engineering, ASCE/UOW, 1993
Soil Nailing and Reinforced Soil Walls, ASCE/UOW, 1992
ASTM Slurry Wall Symposium, 1991
Geology of Puget Sound and Landslide Hazards, ASCE/AEG/UOW, 1991
Fundamentals of Health and Safety at Hazardous Waste Sites - 40 Hour Training, 1990

Design Professionals and the Law, WA State Bar Assoc., 1989
Design and Construction Using Geotextiles, ASCE, 1988

RESUMÉ

Gary A. Pascoe, Ph.D., DABT

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Port Townsend, WA 98368
(360) 385-9977
(b) (6)

ACADEMIC TRAINING

Ph.D., Comparative Pharmacology and Toxicology, (b) (6) University of California, San Francisco. Dissertation title: *Intestinal Cytochrome P-450. Regulation by Gastrointestinal Hormones, and Dietary Nutrients and Xenobiotics.*

B.A., Biology, (b) (6) University of California, San Diego.

Biology, (b) (6) . San Diego State University.

PROFESSIONAL CERTIFICATIONS

Diplomate, American Board of Toxicology (DABT), (b) (6)

Registered Environmental Assessor (REA-04198), California EPA, (b) (6)

CURRENT AND PREVIOUS POSITIONS

Independent Consultant, 1999 – present. Pascoe Environmental Consulting, Port Townsend, WA. Consulting in toxicology, ecological and human health risk assessment, sediment evaluations, and regulatory compliance.

Senior Scientist/Program Manager, 1995 - 2002. EA Engineering, Science, and Technology, Inc., Bellevue, WA. Consulting in sediment evaluations, ecological and human health risk assessment, regulatory compliance, and toxicology. Manager of RI/FS and risk assessment projects.

Consulting Scientist, 1997-1999. Natural Resources Consultants Inc., Seattle, WA. Consulting services in ecological risk assessment and marine aquatic toxicology.

Vice President, Technical Affairs, 1993 - 1995; **Technical Director,** 1991 - 1993; **Senior Toxicologist,** 1989 - 1990. Environmental Toxicology International, Inc., Seattle, WA. Specialists in risk assessments and toxicology. Roles included guidance on technical direction of the company, management of government sector programs and large technical projects, staff training in technical and managerial skills, technical staff performance evaluations, client consultations, proposal management, assistance in finances and marketing.

Toxicologist, 1988-1989. Tetra Tech, Inc., Bellevue, WA. Project/task management for private and government clients in risk assessment, regulatory compliance, and toxicology evaluations.

Research Associate, 1986-1987. Department of Medicinal Chemistry, University of Washington, Seattle, WA. GC and LC/MS analyses of reactive metabolites and protein-bound contaminant residues; effects of antioxidants on xenobiotic metabolism and protein binding.

Research Associate, 1983-1986. Environmental Health Sciences Center., Oregon State University, Corvallis, OR. Development of hepatocyte models of chemical toxicity and oxidative stress; interactions of cellular redox systems with endogenous antioxidants during chemical insult.

Teaching Assistant, 1979-1982. Department of Pharmacology, U.C. San Francisco.

Research Assistant, 1978-79. Department of Pharmacology, U.C. San Francisco. Management of data collection for toxic effects code for the *Registry of Toxic Effects of Chemical Substances.*

Teaching Assistant, 1976. Department of Biology, San Diego State University.

PROFESSIONAL EXPERIENCE IN MARINE SCIENCES

LITIGATION SUPPORT/EXPERT WITNESS

- Technical assistance and review of marine fish and benthic invertebrate toxicity studies, and sediment natural recovery analyses, for the Commencement Bay Natural Resource Damage Assessment.
- Provided expert witness testimony to the mining industry on the potential for heavy metals in soil runoff to adversely affect marine biota. Evaluated factors in estuarine surface waters and sediments that govern the bioavailability of metals.
- Litigation support on risks to the marine environment from paper mill discharges of dioxins and metals. Co-design of sampling program for soils, surface water and sediments of lakes and marine waters, and evaluation of program results.
- Technical review of a NEPA permit application to build a trans-mountain pipeline for refined petroleum products. Compared potential ecological impacts with the risks of alternative ocean and river barging.

Ecological Assessments

- Manager of a Remedial Investigation/Feasibility Study for mercury and ordnance-contaminated sediments of a Navy site in Puget Sound. Sediment bioassays, sedimentology, sediment transport, and source identification. Integrated Washington Sediment Management Standards and CERCLA requirements as part of the ecological risk assessment and evaluation of remedial alternatives. Prepared Proposed Plan and Record of Decision.

- Performed an ecological risk assessment under Oregon DEQ guidelines for PAH- and mercury-contaminated sediments in an estuarine bay near the mouth of the Columbia River. Assessment based on benthic bioassays, direct contact and diet for pelagic and demersal fish, and food chain modeling for aquatic mammals and birds.
- Provided technical reviews of ecological risk assessment documents on the estuarine habitat of the lower Duwamish River Superfund site for the City of Seattle.
- Performed a screening-level ecological risk assessment at an oil refinery near Port Arthur, along the Texas Gulf Coast, based on comparisons of chemical concentrations with appropriate criteria.
- Manager and senior author of a feasibility study and proposed plan for two petroleum and chlorinated solvent-contaminated sites at the Naval Arctic Research Laboratory, Barrow, AK.
- Senior technical review and co-manager of an ecological risk assessment at the Naval Arctic Research Laboratory in Barrow, AK. New methodologies were described in a technical approach paper and work plan. Risk-based screening levels for TPH fractions were developed for protection of terrestrial and aquatic ecological receptors in freshwater and estuarine waters in the arctic.
- Produced a white paper review and evaluation of marine sediment studies at a Navy site in Puget Sound. Recommendations to finalize the remedial investigation and feasibility study.
- Manager of post-ROD monitoring program of a marine shoreline and sediment unit at the Keyport Undersea Warfare Division, for the U.S. Navy. Seasonal measurements of groundwater, seeps, sediments, and tissue residue analyses; sediment bioassays.
- Evaluated remedial options to contain contaminated sediments during construction of an aquarium at an estuarine National Park Service site in Charleston, SC.
- Manager and designer of a risk-based model for developing remedial goals for PCBs and TPH in soil, for a Port of Seattle redevelopment project. Focus on protection of marine organisms exposed to groundwater discharges from multiple industrial properties; site-specific attenuation/dilution parameters and chemical partitioning.
- Evaluated sediment toxicity results for the Puget Sound Sediment Monitoring Program, Washington Department of Ecology. Reference area comparisons; covariance analyses with benthos and chemistry.
- Managed an assessment of marine ecological risks due to DDT, PCBs, and heavy metal contamination in sediments and biota of the Southern California Bight. Evaluated effects of major storms and outfall discharges on DDT dynamics in marine sediments and fish tissues. Generated an empirical model of DDT bioaccumulation in demersal fish from contaminated sediments.
- Technical assistance for a sampling plan for sediments, surface waters, and biota of nearshore marine waters in Southeast Alaska contaminated with dioxins and pulp mill effluent chemicals.

- Performed technical evaluations of 12 applications to alter National Pollution Discharge Elimination System (NPDES) permits under the Clean Water Act Section 301(h); focus on toxicity tests, bioaccumulation of organic compounds, and fish histopathology.
- Managed an ecological risk assessment of an abandoned industrial property for the Washington National Guard. Complied with Washington Model Toxics Control Act for a future recreational area. Terrestrial and marine habitats were evaluated for risks from PCBs and metals.
- Managed an evaluation of the potential for over 120 modern pesticides to pollute Puget Sound waters, sediments, and biota. Conducted usage surveys and fate and toxicity data analyses. Designed a level-of-concern approach to prioritize pesticides for future sampling by U.S. EPA.

HUMAN HEALTH STUDIES

- Provided technical reviews of human health risk assessment documents on the estuarine habitat of the lower Duwamish River Superfund site for the City of Seattle.
- Managed the collection of fish from an estuarine lagoon in the North Slope of Alaska, and analyses for petroleum chemicals & TPH for use in assessing risks to Inupiat subsistence fish consumers, for the US Navy.
- Designed a fish sampling program and derivation of site-specific bioaccumulation factor for mercury in a southeastern coastal swamp adjacent to a cement plant burning hazardous waste.
- Senior technical review and co-manager of a human health risk assessment at the Naval Arctic Research Laboratory in Barrow, AK. Risk-based screening levels for TPH fractions and petroleum-related and dry cleaning chemicals were developed for protection of subsistence fishers and hunters at Pt. Barrow.
- Managed and designed an approach for generating risk-based chemical concentrations for managing stored sediments during dewatering at the Port of Oakland. The approach developed a matrix model to regulate exposures due to inhalation and direct contact by workers at the marine terminal and nearby residents.
- Managed a human health risk assessment of an abandoned industrial property along the Puget Sound shoreline, contaminated with PCBs and metals, for the Washington National Guard.
- Technical reviewer of a guidance document for assessing risks from consumption of contaminated seafood; for U.S. EPA Region 10.

Advisory Committees

Science Advisory Board, Ecological Risk Assessment , Washington Department of Ecology, 1996-2000.

Pesticide Incident, Reporting, and Tracking (PIRT) Panel, Washington Department of Health; appointment by Governor, 1990-1998.

PUBLICATIONS

Pascoe, G.A., P. McLaren, and M. Soldate. **2002.** Impact of offsite sediment transport and toxicity on remediation of a contaminated estuarine bay. *Marine Pollution Bulletin* 44:1184-1193.

Pascoe, G.A., and R. Connelly. **2002.** Site-specific bioaccumulation factors for mercury: Impact on health risks from fish consumption. *Proceedings of the Air & Waste Management Association, Specialty Conference on Hazardous Waste Combustion*, April 17, St. Louis, MO.

Pascoe, G.A., M.J. Riley, T.A. Floyd, and C.L. Gould **1998.** Use of a risk-based hydrogeologic model to set remedial goals for PCBs, PAHs, and TPH in soils during redevelopment of an industrial site. *Environmental Science and Technology* 32:813-820.

Pascoe, G.A. **1994.** Role of an ecological risk assessment in reducing uncertainties and remedial costs at a hazardous waste site. In: *Proceedings of the Cost Efficient Acquisition and Utilization of Data in the Management of Hazardous Waste Sites.* Air and Waste Management Association/Waste Policy Institute, Washington, D.C., pp. 242-251.

Pascoe, G.A. **1993.** Wetlands risk assessment. *Environmental Toxicology and Chemistry* 12:2293-2307 (Annual Review).

JERALD D. RAMSDEN, Ph.D., P.E.

Project Manager
Lead Coastal Engineer

Years of Experience
(b) (6)

Education
Ph.D., Civil Engineering, California Institute of Technology, (b) emphasis on coastal engineering);
M.S., Ocean Engineering, Oregon State University (b)
B.S., Civil Engineering, Oregon State University, (6)

Professional Affiliations
American Society of Civil Engineers

Professional Registrations
Oregon, (b) (6); Washington, (b) (6)

Key Qualifications
Jerald Ramsden specializes in coastal engineering and open channel flow. As a consultant, he assists public and private clients in planning and engineering for waterway facility siting, including bankline and channel stabilization, dredging and disposal alternatives development, design and permitting, dilution studies, wave and current loads on structures, and application of mathematical models to analyze coastal, estuarine, and riverine processes. He has performed a wide variety of hydraulic analyses and/or permitting to support facility siting of deep draft terminals, recreational marinas, shoreline redevelopment and enhancement, and repair or maintenance of existing facilities. His clients have included municipalities, regional and national governments, associations, port authorities, other engineering consultants, law firms, and private industry.

Jerald has assisted clients in numerous projects involving proposed fill or structures placed within the floodway and floodplain. He has provided both hydraulic engineering and permitting expertise on these projects, including local shorelines, state, and federal regulatory requirements. He routinely serves as his client's authorized permitting representative and assists clients in negotiations and coordination with the various resource and regulatory agencies. He has provided technical information to meet Federal Emergency Management Agency (FEMA) guidelines for documentation of floodrise effects associated with several types of in-water developments, including deep draft terminals, bankline development (including fill or other structures), and bankline repairs or enhancements.

Jerald has also developed and refined computer programs for the analysis of extreme winds, wind wave generation, and wave loads on pile supported floating structures. He performs computer analyses for floodrise determinations; steady and unsteady river flows; wind and vessel wake generation; wave transformations across complex bathymetry, including refraction, diffraction, shoaling, and wave energy dissipation; wave and current loads on a variety of structures; digital terrain modeling; and dredge prism development and design. His work has included the design and oversight of field studies to monitor river currents and vessel-generated waves.

Previous Experience
Prior to joining Parsons Brinckerhoff (PB), Jerald served as a coastal engineer with a consulting engineer firm and managed numerous projects in the areas of dredging and disposal, sediment remediation, coastal engineering, open channel hydraulics, numerical modeling, field studies, and permitting. His clients included municipalities, associations, port authorities, regional and national governments, consultants, and law firms.

Dredging, Disposal, and Sediment Remediation

- Wood debris and contaminated sediment dredging as well as sediment capping, including planning, remediation alternatives development and evaluation, design, construction plans, specifications, construction management support and as-built drawings in Upper Hylebos Waterway Turning Basin, Tacoma, Washington
- Hydraulic analyses for a proposed sediment cap, including analyses of winds, wind waves, vessel wake, wave transformations over complex site bathymetry and sediment stability, McCormick and Baxter Superfund Site, Willamette River, Portland, Oregon
- Carrier berth dredging plans and disposal options for clean and contaminated sediment dredging in four ship berths, two turning basins, and one entrance channel, Puget Sound Naval Shipyard, Bremerton, Washington
- Analysis of sedimentation patterns and assisted in development of new work dredging plan configuration for a proposed intermodal facility at the Port of Anchorage, Anchorage, Alaska
- Dredging and material handling plan for removal of depositional sediment in Capitol Lake, Olympia, Washington
- Concept plans for upland, nearshore, and aquatic dredged material disposal sites, Puget Sound, Washington
- Input on dredging and disposal planning and design as well as review of technical specifications and plans for contaminated sediment remediation at a former shipyard, Coos Bay, Oregon
- Dredging and disposal as well as capping alternatives development and evaluation for sediment remediation in Buffalo Slough as part of Columbia Slough restoration, Portland, Oregon
- Dredge plan, mitigation plan, permitting and Endangered Species Act consultation for maintenance dredging at four facilities within an industrial complex on the Columbia River, Vancouver, WA
- Dredging plans and technical specifications for a proposed marina on Tomahawk Island, Columbia River, Portland, Oregon
- Dredging plans, sediment characterization, and permitting for dredging to maintain industrial water intake at a steel mill, Willamette River, Portland, Oregon
- Dredge plan and permitting to deepen a federally authorized access channel, Columbia River, Longview, Washington

Coastal Engineering

- Analysis of wind waves and nearshore wave transformation effects for design of new bankline protection revetment, Barbour's Cut, Port of Houston, Texas
- Quality control review of coastal engineering analysis and breakwater design for a new one-mile long perimeter berm that will serve as a dredged material confinement facility for expansion at the Port of Brisbane, Australia
- Analysis of wave action and design wave pressure distribution on a proposed bulkhead, including ocean swell, tsunamis, hurricane surge, and wind waves, Pearl Harbor, Hawaii
- Value engineering analysis for the North Jetty Repair Project, Yaquina Bay, Newport, Oregon
- Analysis of tides and wind waves, planning and conceptual design of two ferry berth terminals, including jetties, Cold Bay, Alaska
- Analysis of wind waves for sedimentation and maintenance dredge planning for the Port Orford dock, Port Orford, Oregon
- Analysis of ocean wave conditions, nearshore wave transformation effects and cape class vessel response for a deep-draft bulk offload facility feasibility study, Baja California, Mexico

- Feasibility study for barge unloading facility including winds, wind waves, and wave transformation through complex bathymetry; generated wave statistics for operational conditions and design events, coastal location, Southeast Alaska
- Analysis of wind wave generation, nearshore wave transformation and wave conditions within a proposed homeport berth for a U.S. Coast Guard Patrol Boat, Tongue Point, Columbia River Estuary, Astoria, Oregon
- Numerical water wave refraction analysis for the Goleta Point Outfall, Santa Barbara, California
- Physical model study of breakwater overtopping, Buffalo, New York
- Breakwater rehabilitation study, including analyses of wind waves, wave forces, and combined refraction, diffraction, and shoaling of water waves, East Boat Basin, Columbia River, Astoria, Oregon
- Hydraulic analyses for a proposed boat launch, including wind waves, ship waves, combined refraction, diffraction, and shoaling of water waves, sedimentation, flood-induced currents, and hydraulic loads on a soldier pile breakwater, Columbia River, Cowlitz County, Washington
- Wave force analysis for dock failure litigation, Rose City Yacht Club, Columbia River, Portland, Oregon
- Analysis of wind waves, flood currents, water levels, and hydraulic loads on a dock for piling design, Portland Yacht Club, Columbia River, Portland, Oregon
- Analysis of ship wake, wind waves, water levels, and flood currents to determine wave transmission and hydraulic loads on floating wave attenuators and sheet pile walls for a proposed boat launch, Columbia River, Rainier, Oregon
- Analysis of winds, wind waves (including numerical analysis of refraction, diffraction, and shoaling), flood stages, and currents for use in design of bankline stabilization at The Shire, Columbia River, Skamania County, Washington

Waterway Engineering and Permitting

- Scour analysis and review of hydraulics, wave and ice conditions for feasibility of a new bridge over the Knik Arm of Prince William Sound, Anchorage, Alaska
- Dilution study for a new proposed outfall serving up to four industrial users at Port Westward on the Columbia River, Clatskanie, Oregon
- Detroit-Windsor automobile tunnel armor cover inspection including planning and monitoring of dive crew activities at the site, assessment of hydrographic survey results and reporting on condition of the tunnel cover, Detroit River, Detroit, Michigan
- Dilution study for a thermal outfall in the lower Columbia River to support a National Pollution Discharge Elimination System (NPDES) permit renewal, Portland General Electric, Beaver Generating Plant, Clatskanie, Oregon
- River operations modeling using the numerical model HEC5 for Federal Energy Regulatory Commission (FERC) relicensing of five hydropower reservoirs, Clackamas River, Oregon
- Dilution study for NPDES permit extension, Portland General Electric, Trojan Nuclear Power Plant, Rainier, Oregon
- River bankline failure mechanisms, including wind wave and boat wave erosion and stage-discharge relationships, Red River, Winnipeg, Manitoba
- Floodway encroachment analyses, Oregon Steel Mills, Willamette River, Portland, Oregon, and Salem Waterfront, Salem, Oregon

- Hydraulic analysis of potential floodway impacts, assessment of surface water hydrology, and a field study to document the wake caused by a barge permanently moored in a river for the West Hayden Island Development Environmental Impact Statement, Port of Portland, Portland, Oregon
- Hydraulic analyses for bankline repair, floodway impact due to revetment construction, and a spillway for flood flow management, North Santiam River, Stayton, Oregon
- Independent technical review of hydraulic design for four fishing treaty access sites on the Columbia River between White Salmon, Washington and Arlington, Oregon
- City of Rainier Marina master plan development, conceptual design, and cost estimates, Columbia River, Rainier, Oregon
- River bankline repair permitting on the Columbia River at Lieser Point and Columbia Shores in Vancouver, Washington, and the Jantzen Beach Hotel, Portland, Oregon
- Hydraulics and permitting for brownfields waterfront redevelopment and bankline enhancement, North Macadam District, Willamette River, Portland, Oregon
- Design and permitting for bankline repair at International Terminals, Willamette River, Portland, Oregon
- Ship wave inundation study, Columbia River, Austin Point, Woodland, Washington
- Hydraulic analyses for shoreline redevelopment and bankline enhancement, North Macadam District, Willamette River, Portland, Oregon

Teaching Experience

From (b) (6) erald held the position of assistant professor of civil engineering at Clemson University, in South Carolina, where he taught upper division courses. These included a course in numerical analysis, a senior-level design course in hydraulics and hydrology, and a graduate course in open-channel flow. In addition to his teaching responsibilities, Jerald also advised graduate students and conducted sponsored research in the area of coastal engineering and water quality modeling.

Publications/Presentations

- "Hydraulic analyses and design of a sediment cap at a Superfund Site," Abstract accepted, to be presented at the Coastal Structures 2003 conference in Portland, OR, August, 2003.
- "Hydraulic Analyses for Design of a Sediment Cap at a Superfund Site," presented at the 25th Annual Meeting of the Pacific Estuarine Research Society, Portland, Oregon, May 2-4, 2002.
- "Estimation of Breakwater Sheltering using the Refraction-Diffraction Wave Transformation Model REF/DIF I," presented at the 11th Annual Meeting of the States Organization for Boating Access, National Conference, September, 28 through Oct. 1, 1997, Portland, Oregon,
- "Forces on a Vertical Wall Due to Long Waves, Bores, and Dry-Bed Surges," published in *Journal of Waterway, Port, Coastal, and Ocean Engineering*, American Society of Civil Engineers, Vol. 122, No. 3, May/June 1996.
- Coauthor, "Harbor Wave Conditions Due to Breakwater Overtopping," published in *Proceedings Coastal Engineering Practice*, American Society of Civil Engineers, Long Beach, California, 1992.
- "Forces on a Vertical Wall Caused by Incident Bores," published in *Journal of Waterway, Port, Coastal, and Ocean Engineering*, American Society of Civil Engineers, Vol. 116, No. 5, September/October 1990.
- Coauthor, "Bottom Pressures Due to Long Waves: Laboratory and Field Measurements," published in *Proceedings 22nd International Conference on Coastal Engineering*, 1990.

- "Kinematics and Return Flow in a Closed Wave Flume," published in *Proceedings 21st International Conference on Coastal Engineering*, 1989.

Jerald has served as a reviewer for the American Society of Civil Engineers publications of *Journal of Waterway, Port, Coastal and Ocean Engineering*, *Journal of Hydraulic Engineering*, and for the *Journal of Environmental Engineering*, and has assisted the National Science Foundation in reviewing research proposals regarding coastal engineering and tsunami effects.